

IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF OHIO
EASTERN DIVISION

IN RE NATIONAL	:	MDL No. 2804
PRESCRIPTION OPIATE	:	CASE NO. 17-MD-2804
LITIGATION	:	(DAP)
	:	

EXPERT REPORT OF CRAIG J. MCCANN, PH.D., CFA
March 25, 2019

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I. Qualifications and Remuneration

A. Qualifications

1. I am the President of Securities Litigation and Consulting Group, Inc. (“SLCG”). SLCG was founded in 2000 to apply finance, economics, statistics and mathematics in litigation and consulting. SLCG staff includes professionals with PhDs and advanced degrees in applied mathematics, statistics, finance and economics.

2. Prior to founding SLCG, I was a Director at LECG, a business unit of Navigant Consulting, Inc. Prior to joining LECG, I was Managing Director, Securities Litigation at KPMG LLP for two years. I was a senior financial economist in the Office of Economic Analysis at the U.S. Securities and Exchange Commission (the “SEC”) from 1992 to 1993 and from 1994 to 1995.

3. I have taught graduate economics and finance courses at the University of South Carolina, Virginia Tech, Georgetown University and at the University of Maryland, College Park.

4. I have been hired as a consultant and expert witness in investigations by many state and federal agencies including the SEC, the Federal Deposit Insurance Corporation and the U.S. Department of Justice.

5. My work as a consultant and expert witness over the past 25 years has required me to extract or receive data, process and validate the data and produce varied statistical analyses.

6. I earned a Ph.D. in Economics from the University of California, at Los Angeles. My graduate studies included extensive coursework in mathematics, statistics and econometrics.

7. My resume, which includes a list of all publications authored by me within the last 10 years and the cases in which I have testified as an expert at trial or by deposition within the last four years, is attached as Appendix 1.

B. Remuneration

8. SLCG is being compensated for its time and expenses. My hourly rate is \$475 per hour. Other SLCG personnel working on this matter have billing rates of \$100 to \$350 per hour.

II. Materials Reviewed

9. In preparing this report, I have considered the following documents:

- a. Automation of Reports and Consolidated Orders System (ARCOS) electronic data, received from the Drug Enforcement Administration (hereafter, “ARCOS Data”);
- b. “ARCOS Retail Drug Summary Reports,” Drug Enforcement Administration, 2000-2017, (available at www.deadiversion.usdoj.gov/arcos/retail_drug_summary/index.html);
- c. “National Drug Code Dictionary,” Drug Enforcement Administration, November 2018 (current version available at www.deadiversion.usdoj.gov/arcos/ndc/ndcfile.txt);

- d. “NDC Dictionary Instructions,” Drug Enforcement Administration, October 2010 (current version available at www.deadiversion.usdoj.gov/arcos/ndc/readme.txt);
- e. “NDC/NHRIC Labeler Codes,” U.S. Food & Drug Administration, January 2018 (current version available at www.fda.gov/ForIndustry/DataStandards/StructuredProductLabeling/ucm191017.htm);
- f. “Opioid Oral Morphine Milligram Equivalent (MME) Conversion Factors,” Centers for Disease Control and Prevention, August 2017 (current version available at www.cdc.gov/drugoverdose/resources/data.html);
- g. “Full Replacement Monthly NPI File,” Centers for Medicare and Medicaid Services, November 2018 (current version available at download.cms.gov/nppes/NPI_Files.html);
- h. ARCOS Registrant Handbook, Drug Enforcement Administration, August 1997 (current version available at www.deadiversion.usdoj.gov/arcos/handbook/full.pdf);
- i. *Masters Pharmaceutical, Inc. v. Drug Enforcement Administration*, 861 F.3d 206 (D.C. Cir. 2017);
- j. U.S. Dep’t of Justice, DEA, *Chemical Handler’s Manual: A Guide to Chemical Control Regulations* (2004), (WAGMDL00395965);
- k. U.S. Dep’t of Justice, DEA, *Diversion Investigators Manual* (1990)(CAH_MDL_PRIORPROD_DEA07_01176247);

l. U.S. Dep't of Justice, DEA, Diversion Investigators Manual (1996) (CAH_MDL2804_02203353);

m. Other documents cited in the text and footnotes below.

III. Assignment

10. I have been asked by Plaintiffs' Counsel to document how I processed, validated and augmented opioid transaction data produced by the Drug Enforcement Administration ("DEA") and from the Defendants.

11. I have been asked to summarize shipments in the ARCOS Data, especially those shipments into Cuyahoga County and Summit County.

12. I have also been asked to report the results of applying certain algorithms to the ARCOS Data.

IV. Summary of Opinions

13. Based upon my comparison of the ARCOS Data produced by the DEA and the public ARCOS Retail Drug Summary Reports, I conclude that, after correcting a relatively small number of records, the ARCOS Data produced by the DEA is reliable.

14. I conclude that the ARCOS Data is reliable because it closely matches the DEA's Retail Drug Summary Reports for January 2006 through December 2014. Retail Drug Summary Reports summarize the weight of drugs in reported transactions with consumers in each of the 50 states and the District of Columbia. Where there were discrepancies between the ARCOS Data produced by the DEA and the Retail Drug Summary Reports, I was able

to identify and correct the error in either the ARCOS Data or the Retail Drug Summary Reports.

15. The ARCOS Data produced by the DEA also closely matches transaction data produced in discovery by Cardinal Health, McKesson Corp, Walgreens, CVS, Anda, H.D. Smith, Walmart, HBC, Discount Drug Mart, and Prescription Supply from their business records. I expect the data produced in discovery by the Defendants to be accurate. As with the Retail Drug Summary Reports, I have been able to identify and correct relatively minor discrepancies between the ARCOS Data produced by the DEA for transactions in Cuyahoga County and Summit Counties in Ohio from January 2006 through December 2014 and the Defendants' transaction data.

16. The data on opioid shipments from January 2006 through December 2014 produced in discovery by AmerisourceBergen does differ from what AmerisourceBergen reported to the DEA as reflected in the ARCOS Data.

17. I conclude from my review of the ARCOS Data, the Retail Drug Summary Reports, and transaction data produced in discovery by the Defendants that the ARCOS Data is reliable. Based on this analysis, I further conclude that the transaction records produced in discovery by the Defendants other than AmerisourceBergen are a reliable source of transactions data before 2006 and after 2014 for the varied time periods covered by the Defendants' productions.

18. In the next section, I describe the ARCOS Data produced by the DEA and report national summary statistics for the ARCOS Data, after correcting minimal errors explained fully in Appendix 2. In Section VI, I

compare the processed ARCOS Data to Retail Drug Summary Reports published by the DEA to verify that the shipments of opioids to dispensing outlets in the ARCOS Data is consistent with the amount of each opioid the DEA calculates was shipped into each 3-digit zip code each quarter. I also compare the ARCOS Data to the opioid transaction data produced in discovery by the Defendants.

19. In Section VII, I explain the information I used to supplement the ARCOS Data.

20. In Section VIII, I report summary statistics for subsets of the processed ARCOS Data covering Cuyahoga County and Summit County in Ohio. These summary statics show that that between 2006 and 2014, Dispensers in Cuyahoga County received 8.55 billion MME of opioids. Given the county's 1.28 million average population, Dispensers received enough opioids for every resident in the County to consume 742 MME every year from 2006 to 2014. These summary statistics also show that between 2006 and 2014, Dispensers in Summit County received 5.16 billion MME of opioids. Given the County's average population of 542,000, Dispensers received enough opioids for every resident in the county to consume 1,057 MME every year from 2006 to 2014.

21. In Section IX, I describe a non-exhaustive set of algorithms that can be systematically applied to the ARCOS Data and present a check on the various estimates presented. In Section X, I provide certain estimates regarding the total aggregate shipments of opioids into Ohio from 1997 to 2018. In Section XI, I describe certain charts and tables that are attached to this report. In Section XII I give my conclusions.

22. I continue to review documents and gather information and reserve the right to update my analysis and opinions based upon that further review of documents and based on any new information - including possibly reports of other experts - I may receive.

V. ARCOS Data

23. ARCOS is the system through which manufacturers and distributors report transactions of controlled substances to the DEA.¹ ARCOS Data covers all fifty states, the District of Columbia, Puerto Rico, Guam, U.S. Virgin Islands, American Samoa, and Northern Mariana Islands, Armed Forces-Americas, Armed Forces-EMEA, Armed Forces-Pacific, and Palau.

A. Receipt of ARCOS Data from the DEA

24. The DEA produced a subset of ARCOS Data reflecting transactions in drug products containing one or more of fourteen drugs: buprenorphine, codeine, dihydrocodeine, fentanyl, hydrocodone, hydromorphone, levorphanol, meperidine, methadone, morphine, powdered opium, oxycodone, oxymorphone, and tapentadol from January 1, 2006 through December 31, 2014.

25. On or about April 20, 2018 the DEA produced ARCOS Data produced reflecting transactions in oxycodone, hydrocodone, hydromorphone, and fentanyl for six states: Alabama, Florida, Illinois, Michigan, Ohio and West Virginia. On or about May 20, 2018 the DEA produced transaction data for these four drugs for the remaining states. The

¹ www.deadiversion.usdoj.gov/arcos/index.html, accessed on 29 November 2018.

May 20, 2018 production was missing pharmacy names and had some duplicate transactions and obvious errors. At my request, the DEA reproduced the May 20, 2018 data with pharmacy names and errors in the May 20, 2018 production largely corrected on or about June 5, 2018.

26. Additionally, the DEA produced ARCOS Data for all states for oxymorphone, tapentadol, buprenorphine, and morphine on or about July 6, 2018; for codeine, dihydrocodeine, meperidine, and powdered opium on or about July 24, 2018; and for methadone and levorphanol on or about August 28, 2018. The timing and amount of ARCOS Data produced by the DEA is summarized in Table 1. In total, the ARCOS Data has 500,709,803 transaction records – 444,819,182 transaction records involving Dispensers.²

² As explained more fully below I use “Dispensers” to refer to businesses that dispense drugs to patients such as pharmacies and hospitals as opposed to distributors who receive drugs and then ship to businesses as opposed to patients.

Table 1 ARCOS Opioid Transaction Data Produced by DEA

Drug Name	Drug Code	# of All Transactions	Transactions with Dispensers				
			# of Transactions	Dosage Units	Dosage Units %	Calculated Base Weight	Calculated Weight %
Received June 5, 2018							
Hydrocodone	9193	189,611,242	174,829,777	74,285,510,348	53.04%	436,729,519	25.85%
Oxycodone	9143	116,411,941	106,210,465	39,978,942,635	28.54%	494,278,594	29.25%
Fentanyl	9801	51,159,276	42,971,667	914,488,221	0.65%	8,096,158	0.48%
Hydromorphone	9150	17,446,169	14,435,387	2,571,523,184	1.84%	15,161,478	0.90%
Subtotal		374,628,628	338,447,296	117,750,464,388	84.07%	954,265,749	56.48%
Received July 6, 2018							
Morphine	9300	49,243,546	39,880,848	6,365,919,333	4.55%	222,022,285	13.14%
Buprenorphine	9064	26,275,507	24,153,401	1,857,399,214	1.33%	152,570,080	9.03%
Oxymorphone	9652	6,033,613	5,008,054	633,293,763	0.45%	11,042,968	0.65%
Tapentadol	9780	3,376,288	2,827,854	353,918,908	0.25%	28,776,260	1.70%
Subtotal		84,928,954	71,870,157	9,210,531,218	6.58%	414,411,593	24.53%
Received July 24, 2018							
Codeine	9050	17,644,740	14,728,585	5,904,595,163	4.22%	149,048,894	8.82%
Meperidine	9230	6,069,787	4,439,671	296,424,349	0.21%	25,276,542	1.50%
Dihydrocodeine	9120	1,150,066	762,778	47,182,023	0.03%	1,051,401	0.06%
Opium, Powdered	9639	509,879	335,515	8,000,328	0.01%	383,634	0.02%
Subtotal		25,374,472	20,266,549	6,256,201,863	4.47%	175,760,471	10.40%
Received August 28, 2018							
Methadone	9250	15,668,247	14,167,720	6,829,158,005	4.88%	145,228,224	8.59%
Levorphanol	9220	109,502	67,460	14,402,593	0.01%	18,947	0.00%
Subtotal		15,777,749	14,235,180	6,843,560,598	4.89%	145,247,171	8.60%
Total		500,709,803	444,819,182	140,060,758,067	100.00%	1,689,684,984	100.00%

B. ARCOS Data Fields Produced by DEA

27. The ARCOS Data produced by the DEA has the 34 fields illustrated in Figure 1 for each transaction record. Twelve of the 34 fields are submitted with each transaction record by the Reporting Registrant, the DEA registered entity reporting the opioid shipment through ARCOS. These twelve fields are defined in the ARCOS Handbook.³ The remaining 22 fields were appended by the DEA to the transaction records submitted by the Reporting

³ “ARCOS Registrant Handbook,” Drug Enforcement Administration, August 1997 (“ARCOS Handbook”). Current version available at www.deadiversion.usdoj.gov/arcos/handbook/full.pdf.

Registrant.⁴ Eighteen of the 22 fields are information about the Reporting Registrant and the Associate Registrant, keyed off their DEA numbers.⁵ Three of the remaining four fields are either taken from the NDC (for National Drug Code) Dictionary or are calculated using variables therein and appear to have been imported by the DEA into the data it produced by matching each transaction's NDC number with the NDC number in the NDC Dictionary.⁶

Figure 1 ARCOS Data Fields Produced by DEA

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
Reporter / Seller Info										Buyer Info										Transaction Info													
DEA #	Business Activity	Name	Addtl Co Info	Address1	Address2	City	State	Zip	County	DEA #	Business Activity	Name	Addtl Co Info	Address1	Address2	City	State	Zip	County	Transaction Code	Drug Code	NDC Number	Drug Name	Quantity	Unit	Action Indicator	Order Form Number	Correction Number	Strength	Transaction Date	Calc Base Weight Grams	Dosage Unit	Transaction Id

28. The first 10 fields provide information on the Reporting Registrant. The DEA identified these Reporter DEA numbers and associated fields as “Seller” fields and so, unless the context requires otherwise, I refer to the Reporting Registrant as the “Seller” and the associated fields as “Seller” fields. This information includes a Seller’s DEA Number, a description of the

⁴ The 22 fields are Reporter Business Activity, Reporter Name (2 fields), Reporter Address (6 fields), Buyer Business Activity, Buyer Name (2 fields), and Buyer Address (6 fields), Drug Code, Drug Name, Calculated Base Weight in Grams, and Dosage Unit.

⁵ The 18 fields are Reporter Business Activity, Reporter Name (2 fields), Reporter Address (6 fields), Buyer Business Activity, Buyer Name (2 fields), and Buyer Address (6 fields).

⁶ Drug Code and Drug Name are both in the NDC Dictionary. Calculated Base Weight in Grams is calculated using Ingredient Base Weight in the NDC Dictionary and Quantity, Unit, and Strength in the ARCOS Data.

Seller's Business Activity (primarily Manufacturer, Distributor or Reverse Distributor), Name and Address (6 fields).

29. The next 10 fields provide information on the Associate Registrant, typically a receiver of the opioid shipment.⁷ The DEA identified the Associate Registrant DEA numbers and associated fields as "Buyer" fields and so, unless the context requires otherwise, I refer to the Associate Registrant as the "Buyer" and the associated fields as "Buyer" fields. This information includes the Buyer's DEA Number, a description of the Buyer's Business Activity (primarily Distributor or Retail or Chain Pharmacy), Name and Address (6 fields).

30. The final 14 fields provide information about the transaction. This information includes Drug Name and Drug Code (e.g. 9143 for oxycodone products), NDC Number, Quantity, Unit, Strength, Dosage Unit, Calculated Base Weight in Grams, Transaction Code (e.g., whether the transaction was a Purchase or a Sale), Transaction Date, Transaction Identifier, Correction Number, Action Indicator, and Order Form Number.

1. Seller DEA Number

31. The ARCOS Data produced by the DEA includes 1,506 distinct Seller DEA Numbers. Manufacturers and distributors typically have more than one DEA number as each facility manufacturing or distributing controlled substances must have its own DEA number.⁸

⁷ See, ARCOS Handbook at pp. 5-36 – 5-37.

⁸ See, ARCOS Handbook at 1-5.

2. *Seller Business Activity*

32. The ARCOS Data lists one “Business Activity” for each Seller DEA Number. There are six distinct Seller Business Activities in the ARCOS Data: Manufacturer, Manufacturer (Bulk), Chemical Manufacturer, Distributor, Chempack/SNS Distributor, and Reverse Distributor.

3. *Seller Name and Address*

33. The ARCOS Data provides a business address for each Seller DEA Number, but there is not a one-to-one mapping between the addresses and the Seller DEA Numbers. Some Seller DEA Numbers are associated with multiple addresses, and some addresses are associated with more than one contemporaneous Seller DEA Number. Multiple Seller DEA Numbers can also be associated with the same address over time as locations are occupied by businesses newly registered with the DEA.

4. *Buyer DEA Number*

34. The ARCOS Data includes 304,785 distinct Buyer DEA Numbers. 1,465 DEA numbers are listed as both Sellers and Buyers, although not in the same transaction.

5. *Buyer Business Activity*

35. The ARCOS Data includes 54 distinct Buyer Business Activities including Manufacturer, Distributor, Reverse Distributor, Analytical Lab, Retail Pharmacy, Chain Pharmacy, Mail Order Pharmacy and Hospital/Clinic. Some Buyer DEA Numbers have more than one Buyer Business Activity.

6. *Buyer Name and Address*

36. The ARCOS Data provides a business address for each Buyer DEA Number, but there is not a one-to-one mapping between the addresses and the Buyer DEA Numbers. Some Buyer DEA Numbers are associated with

multiple addresses, and some addresses are associated with more than one contemporaneous Buyer DEA Number. Multiple Buyer DEA Numbers can also be associated with the same address over time as locations are occupied by businesses newly registered with the DEA.

7. *Transaction Codes*

37. Each transaction record includes a code which identifies whether the transaction being reported increases or decreases the Reporter's inventory of the drug. In my later analysis, I focus on transaction code "S" which denotes a transaction in which a drug is shipped from the Seller, typically a distributor, to a Buyer, typically a pharmacy. Appendix 3 reports the percentage of transactions in the ARCOS Data in each Transaction Code and provides the ARCOS Handbook description.⁹

8. *Drug Code and Drug Name*

38. The Drug Code is a four digit Administration Controlled Substance Code Number common to each controlled substance or basic class thereof.¹⁰ For instance, whether delivered through skin patches or nasal sprays, fentanyl transactions are identified by the Drug Code 9801 and whether formed in 5 mg or 20 mg tablets, oxycodone transactions are identified with the Drug Code 9143. See Table 2.

⁹ ARCOS Handbook §5.4.3, p. 5-7.

¹⁰ See, Controlled Substances by DEA Drug Code Number, Current version available at https://www.deadiversion.usdoj.gov/schedules/orangebook/d_cs_drugcode.pdf; see also, 21 CFR 1308.03.

Table 2 Drug Codes and Drug Names in the ARCOS Data

Sorted by Drug Name		Sorted by Drug Code	
Drug Code	Drug Name	Drug Code	Drug Name
9064	Buprenorphine	9050	Codeine
9050	Codeine	9064	Buprenorphine
9120	Dihydrocodeine	9120	Dihydrocodeine
9801	Fentanyl	9143	Oxycodone
9193	Hydrocodone	9150	Hydromorphone
9150	Hydromorphone	9193	Hydrocodone
9220	Levorphanol	9220	Levorphanol
9230	Meperidine	9230	Meperidine
9250	Methadone	9250	Methadone
9300	Morphine	9300	Morphine
9639	Opium	9639	Opium
9143	Oxycodone	9652	Oxymorphone
9652	Oxymorphone	9780	Tapentadol
9780	Tapentadol	9801	Fentanyl

9. *National Drug Code*

39. Drug packages are uniquely identified in the ARCOS Data by a National Drug Code, or NDC. The NDC has three segments, which identify the drug product's manufacturer or distributor, active ingredient, strength and formulation of the product, and the package size.¹¹ For example, 00603-3882-28 identifies Par Pharmaceutical manufactured 7.5 mg hydrocodone / 500 mg acetaminophen tablets in packages of 30. NDCs ending in "***" identify bulk packages of the drug identified by the first 9 digits of the NDC.

40. There are 23,280 unique NDCs in the ARCOS Data. The controlled substances in each drug product are identified by a separate Drug Code.

¹¹ "NDC Dictionary Instructions," Drug Enforcement Administration, October 2010. Current version available at <https://www.deadiversion.usdoj.gov/arcos/ndc/readme.txt>.

10. *Quantity*

41. Quantity is the number of packages, weight or volume reported in the transaction.¹² A package can take many different forms, including a bottle of pills, a bottle of liquid, a box containing multiple bottles of drug product, a container of bulk drug powder, a box of skin patches, or a larger box containing smaller boxes of skin patches.¹³

11. *Unit*

42. The Unit code identifies the unit of measurement for the Quantity field. It is used with the Quantity and Strength fields to determine the amount of drug in a transaction.¹⁴ The Unit codes 1, 2, 3 and 4 specify weight units from micrograms to kilograms.¹⁵ See Table 3.

Table 3 Unit of Measurement Codes

<u>Unit</u>	<u>Measurement</u>
1	Micrograms
2	Milligrams
3	Grams
4	Kilograms
5	Milliliters
6	Liters
D	Dozens
K	Thousands

¹² ARCOS Handbook § 5.11.1 p., 5-30.

¹³ ARCOS Handbook § 5.11.

¹⁴ ARCOS Handbook § 5.12.1, p. 5-33.

¹⁵ Since there are 1 billion micrograms in a kilogram, a transaction coded with a 4 in the Unit field when the Quantity field assumes the Units are micrograms will have a Quantity that is 1 billion times too large. Some of the errors I find in the ARCOS Data appear to result from incorrect Unit codes being entered by the Reporting Registrant into ARCOS.

12. Action Indicator

43. The Action Indicator field is either blank or coded D (for delete), A (for adjust) or I (for insert). The Reporter uses transactions coded D to report to the DEA that a previously reported incorrect transaction should be deleted. The Reporter uses transactions coded A to report that a previously reported incorrect transaction should be revised to reflect updated information in the current record. That is, that the previously reported transaction should be replaced with the current transaction record coded A. The Reporter uses transactions coded I to report transactions which should have been reported in a previous month but were not and so are being reported late.¹⁶

13. Order Form Number

44. The Order Form Number identifies a batch of one or more transactions submitted through ARCOS.¹⁷

14. Correction Number

45. The Correction Number identifies a correction transaction which replaces a previously submitted transaction that had been rejected by ARCOS.¹⁸

15. Strength

46. Strength reports the purity of bulk raw material in a transaction, relative to the purity of the NDC, in hundredths of a percentage point. Strength

¹⁶ ARCOS Handbook §5.9.2, p. 5-20 and §7.5, p. 7-12.

¹⁷ ARCOS Handbook §5.14.1, p. 5-38 and §5.14.3, p. 5-40.

¹⁸ ARCOS Handbook, §5.16, p. 5-42.

can also refer to the amount by which a quantity of one in the transaction falls short of or exceeds the standard size package of the NDC.¹⁹

16. Transaction Date

47. Transaction Date is the date a shipment occurred, not the date an order was placed by the Buyer or received by the Seller or the date of some other activity.²⁰

17. Calculated Base Weight in Grams

48. The Calculated Base Weight in Grams is the total active ingredient weight, in grams, of a drug in the reported transaction. The Calculated Base Weight in Grams in the ARCOS Data produced by the DEA was not reported by the Sellers. Rather, it was calculated by the DEA and appended (along with information about the Buyer and the Seller, the Drug Code, the Drug Name, and the Dosage Units) by the DEA before the data was produced. As explained in Appendix 2, I verify the Calculated Base Weight in Grams for each transaction using the NDC Dictionary.

18. Dosage Units

49. Dosage Units is the number of packages in the transaction, multiplied by the number of discrete individual drug products (e.g., pills, patches, lozenges) in each package. Dosage Unit is only populated if the drug product is delivered as a capsule, tablet, film, suppository, patch, lollipop, or lozenge. The Dosage Unit in the ARCOS Data was not reported by the Sellers. Rather, it was calculated by the DEA and appended by the DEA before the

¹⁹ ARCOS Handbook, §5.17, p. 5-43.

²⁰ ARCOS Handbook, §5.15.1, p. 5-40.

data was produced to us. As explained later in this report, I verify Dosage Units for each transaction using the NDC Dictionary.

19. Transaction ID

50. The Transaction ID uniquely identifies the transactions submitted by each Seller each month.²¹ Each Seller restarts the Transaction ID each month at 1. For example, a Seller submitting 33, 41 and 17 transactions over a three month period would submit transactions numbered 1 to 33 the first month, 1 to 41 the second month and 1 to 17 the third month. A later correction, adjustment or deletion should have the same Transaction ID as the record being corrected, adjusted or deleted. A late transaction uses the next available Transaction ID for the month in which the transaction should have been reported, not a Transaction ID for the month in which the late transaction is being reported.

C. Exclusions and Corrections to ARCOS Data

51. The ARCOS Data is composed of transactions, or shipments, of opioids between various entities. Table 4 summarizes the number of transactions, the total Dosage Units, and the total Calculated Base Weight in Grams transacted between various types of entities.

²¹ ARCOS Handbook, §5.18, pp. 5-46 through 5-47.

Table 4 ARCOS Transactions, Grouped by Transaction Participant

	# of Transactions	%	Dosage Units	Dosage Units %	Calculated Base Weight	Calculated Weight %
Shipments to Dispensers						
from Manufacturers	2,762,706	0.55%	1,963,746,971	0.18%	37,570,470	0.00%
from Distributors	422,984,879	84.48%	134,013,039,950	12.07%	1,444,335,948	0.13%
from Reverse Distributors	2,253	0.00%	687,343	0.00%	22,300	0.00%
Total to Dispensers	425,749,838	85.03%	135,977,474,264	12.25%	1,481,928,717	0.13%
Shipments to Distributors						
from Manufacturers	1,550,685	0.31%	291,953,694,524	26.30%	3,179,271,563	0.29%
from Distributors	24,798,146	4.95%	350,052,547,710	31.53%	3,606,767,355	0.33%
from Reverse Distributors	1,327,210	0.27%	107,448,095	0.01%	1,506,287	0.00%
from Dispensers	2,285,969	0.46%	632,110,738	0.06%	6,866,875	0.00%
from Analytical Labs	1,198	0.00%	43,046,052	0.00%	611,594	0.00%
from Other Buyers	40,128	0.01%	1,014,177,881	0.09%	8,865,834	0.00%
Total to Distributors	30,003,336	5.99%	643,803,024,999	57.99%	6,803,889,509	0.62%
Shipments to Manufacturers						
from Manufacturers	151,021	0.03%	97,475,133,509	8.78%	8,778,096,383	0.80%
from Distributors	226,226	0.05%	12,083,288,652	1.09%	94,142,768	0.01%
from Reverse Distributors	110,312	0.02%	2,392,297,817	0.22%	11,910,069	0.00%
from Dispensers	40,899	0.01%	1,875,916,549	0.17%	13,588,120	0.00%
from Analytical Labs	7,807	0.00%	223,368,384	0.02%	2,195,824	0.00%
from Other Buyers	3,045	0.00%	37,359,432	0.00%	66,828,227	0.01%
Total to Manufacturers	539,310	0.11%	114,087,364,343	10.28%	8,966,761,391	0.81%
Shipments to Reverse Distributors						
from Manufacturers	697,001	0.14%	105,770,466,624	9.53%	512,315,637,438	46.56%
from Distributors	1,669,040	0.33%	3,020,403,832	0.27%	42,645,345	0.00%
from Reverse Distributors	5,781,563	1.15%	469,806,226	0.04%	9,848,999	0.00%
from Dispensers	16,738,061	3.34%	1,562,427,349	0.14%	187,184,003	0.02%
from Analytical Labs	64,158	0.01%	127,606,571	0.01%	30,334,732,147	2.76%
from Other Buyers	16,643	0.00%	84,150,318	0.01%	270,182,657	0.02%
Total to Reverse Distributors	24,966,466	4.99%	111,034,860,921	10.00%	543,160,230,589	49.36%
Shipments to Analytical Labs						
from Manufacturers	167,272	0.03%	745,098,504	0.07%	215,457,334	0.02%
from Distributors	14,228	0.00%	115,326,842	0.01%	2,420,568	0.00%
from Reverse Distributors	19,195,712	3.83%	102,987,574,384	9.28%	539,621,113,047	49.04%
Total to Analytical Labs	19,377,212	3.87%	103,847,999,730	9.35%	539,838,990,949	49.06%
Shipments to Other Buyers						
from Manufacturers	20,501	0.00%	658,932,070	0.06%	80,325,531	0.01%
from Distributors	38,625	0.01%	697,580,301	0.06%	10,941,320	0.00%
from Reverse Distributors	8,938	0.00%	1,181,695	0.00%	36,084	0.00%
Total to Other Buyers	68,064	0.01%	1,357,694,066	0.12%	91,302,935	0.01%
Shipments Lost in Transit						
from Manufacturers	106	0.00%	7,191,204	0.00%	94,303	0.00%
from Distributors	4,809	0.00%	89,721,403	0.01%	572,751	0.00%
from Reverse Distributors	662	0.00%	55,064	0.00%	1,071	0.00%
Total Lost in Transit	5,577	0.00%	96,967,670	0.01%	668,125	0.00%
Total	500,709,803	100.00%	1,110,205,385,993	100.00%	1,100,343,772,214	100.00%

52. 85.03% of transactions reported in the ARCOS Data involve shipments to Buyers whose Business Activity suggests they dispense drugs to

patients. I call these Buyers “Dispensers.”²² 3.8% of transactions involve shipments from Dispensers back to manufacturers or distributors.²³ 5.99% of transactions reported in the ARCOS Data involve shipments to Distributors. The number of transactions from Manufacturers to Distributors is small relative to the number of transactions from Distributors to Distributors but the Dosage Units and Calculated Based Weight in Grams is similar.

53. Table 4 is not entirely informative of the actual flow of opioids because some transactions reported by Reverse Distributors (“from Manufacturers” and “to Analytical Labs”) have incorrect Dosage Units and Calculated Base Weights in Grams. I do not use these Reverse Distributor transactions in the analysis I present below.

54. Only 0.03% of transactions are shipments to or from importers, exporters, or researchers (“Other Buyers”).²⁴

55. I removed seven types of transactions from the ARCOS Data before conducting further analysis:

- Obvious duplicate transactions, when the same transaction was reported to ARCOS more than once by the same registrant.

²² I include the following Buyer Business Activities as Dispensers: any Buyer Business Activity beginning with “MLP”; any Buyer Business Activity containing “PHARMACY”, “PRACTITIONER”, “CLINIC”, “MAINT” or “DETOX”; and “AUTOMATED DISPENSING SYSTEM”, “CANINE HANDLER”, and “TEACHING INSTITUTION.”

²³ I include the following Buyer Business Activities as manufacturers or distributors: any Buyer Business Activity containing “MANUF” or “DISTRIB.”

²⁴ Other Buyers have Buyer Business Activity containing “IMPORT”, “EXPORT”, or “RESEARCHER.”

- Transactions where the Drug Code from the NDC Dictionary is not one of the 14 opioids listed in Table 1.
- Transactions where the Action Indicator code, Correction Number, or both suggest the reported transaction is erroneous.
- Transactions involving reverse distributors, analytical labs, importers, exporters, or researchers.
- Transactions reported by the registrant receiving the shipment when two registrants reported the same transaction, keeping the transaction reported by the registrant sending the shipment.
- Transactions with obvious errors in the reported Quantity.
- Transactions where the Transaction Code is “X” (Lost-in-Transit.)

56. I also corrected the Calculated Base Weight In Grams when it was calculated using an incorrect Ingredient Base Weight from the NDC Dictionary. Appendix 2 provides a detailed explanation of these exclusions and corrections.

57. Table 5 summarizes the number of transactions, the total Dosage Units, and the total Calculated Base Weight in Grams transacted between various types of entities after applying the exclusions and corrections.²⁵

²⁵ Table 5 excludes two reported shipments from Manufacturers to Dispensers, where the Transaction Code was “K” (Used in Preparations). The two transactions had a total Calculated Base Weight of three grams. All other shipments to Dispensers had Transaction Code “S” (Sale, Disposition, or Transfer).

Table 5 Corrected ARCOS Transactions, Grouped by Receiver

	# of Transactions	%	Dosage Units	Dosage Units %	Calculated Base Weight	Calculated Weight %
Shipments to Dispensers						
from Manufacturers	2,756,758	0.63%	1,955,505,851	0.37%	28,654,172	0.35%
from Distributors	422,339,037	96.07%	133,869,556,048	25.56%	1,359,862,729	16.72%
Total to Dispensers	425,095,795	96.70%	135,825,061,899	25.93%	1,388,516,901	17.07%
Shipments to Distributors						
from Manufacturers	613,363	0.14%	150,485,506,507	28.73%	1,596,923,572	19.63%
from Distributors	11,387,680	2.59%	174,404,151,077	33.30%	1,768,843,066	21.75%
from Dispensers	2,282,835	0.52%	631,208,631	0.12%	6,292,219	0.08%
Total to Distributors	14,283,878	3.25%	325,520,866,214	62.15%	3,372,058,857	41.46%
Shipments to Manufacturers						
from Manufacturers	77,435	0.02%	55,012,866,965	10.50%	3,318,074,748	40.79%
from Distributors	126,711	0.03%	5,545,996,153	1.06%	42,044,668	0.52%
from Dispensers	40,174	0.01%	1,868,059,604	0.36%	12,840,887	0.16%
Total to Manufacturers	244,320	0.06%	62,426,922,722	11.92%	3,372,960,303	41.47%
Total	439,623,993	100.00%	523,772,850,835	100.00%	8,133,536,061	100.00%

58. Table 5 better reflects the flow of opioids covered by my analysis focused on Dispensers than had Table 4. Table 6 through Table 10 report summaries of the shipments to Dispensers included in Table 5.

D. Shipments to Dispensers in ARCOS Data

59. Table 6 summarizes the shipments to Dispensers reported in the ARCOS Data, by Drug Name sorted by Dosage Units. I separate the two treatment drugs - methadone and buprenorphine – from the other twelve opioids. 82% of the dosage units, 60% of the drug weight and 39% of the MME are in hydrocodone and oxycodone transactions. Fentanyl's ranking by MME is much higher than its ranking by Dosage Units and Calculated Base Weight because of fentanyl's extraordinary potency.

Table 6 Dispenser Transactions in the ARCOS Data, by Drug Name

Drug Name	# of Transactions	Dosage Units	Dosage Units %	Calculated Base Weight	Calculated Weight %	MME	MME %
Hydrocodone	169,417,720	71,520,004,670	52.66%	337,520,360	24.31%	337,520,360,219	12.29%
Oxycodone	102,639,172	39,557,884,546	29.12%	488,441,613	35.18%	732,662,420,250	26.68%
Morphine	36,490,335	6,164,978,649	4.54%	195,114,972	14.05%	195,114,971,785	7.11%
Codeine	13,617,438	5,568,707,097	4.10%	140,445,456	10.11%	21,066,818,383	0.77%
Hydromorphone	13,588,921	2,509,951,291	1.85%	12,806,166	0.92%	51,224,665,106	1.87%
Fentanyl	40,465,457	828,693,025	0.61%	4,275,686	0.31%	431,860,882,781	15.73%
Oxymorphone	4,681,376	604,017,014	0.44%	10,693,667	0.77%	32,081,001,829	1.17%
Tapentadol	2,689,745	342,597,742	0.25%	27,824,743	2.00%	11,129,897,372	0.41%
Meperidine	3,760,914	278,061,325	0.20%	22,791,906	1.64%	2,279,190,573	0.08%
Dihydrocodeine	605,393	35,950,006	0.03%	754,939	0.05%	188,734,669	0.01%
Levorphanol	52,733	12,970,099	0.01%	16,694	0.00%	183,634,514	0.01%
Opium, Powdered	256,174	6,414,740	0.00%	311,973	0.02%	311,972,993	0.01%
Methadone	13,659,231	6,592,381,864	4.85%	134,539,969	9.69%	536,035,539,594	19.52%
Buprenorphine	23,171,186	1,802,449,833	1.33%	12,978,756	0.93%	394,395,972,228	14.36%
Total	425,095,795	135,825,061,899	100.00%	1,388,516,901	100.00%	2,746,056,062,295	100.00%

60. Table 7 summarizes the shipments to Dispensers in the ARCOS Data, grouped by the Seller's Business Activity. Distributors account for 98.6% of Dosage Units, 97.9% of Calculated Base Weight in Grams and 97.9% of morphine milligram equivalents ("MME") shipped to Dispensers. Manufacturers account for 1.4% of Dosage Units, 2.1% of Calculated Base Weight in Grams and 2.1% of MME shipped to Dispensers.

Table 7 Transactions in the ARCOS Data by Seller's Business Activity

Seller Business Activity	Transactions	Dosage Units	Dosage Units %	Calculated Base Weight	Calculated Weight %	MME	MME %
Distributor	422,339,032	133,869,552,948	98.56%	1,359,862,717	97.94%	2,687,154,012,873	97.86%
Manufacturer	2,756,509	1,955,505,751	1.44%	28,630,033	2.06%	58,792,911,471	2.14%
Chempack/Sns Distributor	5	3,100	0.00%	12	0.00%	12,108	0.00%
Chemical Manufacturer	13	100	0.00%	1	0.00%	1,535	0.00%
Manuf (Bulk)	236	0	0.00%	24,138	0.00%	109,124,308	0.00%
Total	425,095,795	135,825,061,899	100.00%	1,388,516,901	100.00%	2,746,056,062,295	100.00%

61. Table 8 summarizes the same transactions, grouped by Buyer's Business Activity. Chain and retail pharmacies received 90% of Dosage Units and 80.9% of MME.

Table 8 Transactions in the ARCOS Data by Buyer's Business Activity

Buyer Business Activity	Transactions	Dosage Units	Dosage Units %	Calculated Base Weight	Calculated Weight %	MME	MME %
Chain Pharmacy	247,195,579	73,886,208,113	54 40%	666,495,461	48 00%	1,234,310,649,809	44 95%
Retail Pharmacy	141,306,746	48,297,495,632	35 56%	514,556,973	37 06%	986,555,996,412	35 93%
Hospital/Clinic	27,136,288	4,442,962,657	3 27%	47,900,984	3 45%	96,872,562,822	3 53%
Hosp/Clinic- Va	2,060,417	3,156,284,263	2 32%	30,861,231	2 22%	55,654,858,497	2 03%
M/O Pharmacy	1,015,020	2,068,917,079	1 52%	22,736,201	1 64%	40,193,271,544	1 46%
Pharmacy - Fed	36,783	1,766,946,083	1 30%	11,013,648	0 79%	7,505,331,082	0 27%
Practitioner	4,378,512	688,587,638	0 51%	7,244,075	0 52%	10,917,133,417	0 40%
Hosp/Clinic- Mil	457,547	567,635,023	0 42%	4,331,900	0 31%	6,349,754,361	0 23%
Maint & Detox	471,691	272,978,092	0 20%	55,707,435	4 01%	209,593,445,006	7 63%
Hosp/Clinic Fed	252,846	197,604,581	0 15%	1,892,101	0 14%	2,282,281,778	0 08%
Central Fill Pharmacy	177,476	158,835,397	0 12%	1,062,854	0 08%	1,432,561,972	0 05%
Practitioner-DW/30	143,164	81,405,163	0 06%	1,134,931	0 08%	2,025,520,251	0 07%
Practitioner-DW/100	173,325	72,330,160	0 05%	879,881	0 06%	3,187,998,099	0 12%
Comp/Maint/Detox	13,065	66,181,228	0 05%	12,379,759	0 89%	47,864,583,656	1 74%
Maintenance	34,640	60,050,461	0 04%	9,301,111	0 67%	37,604,594,020	1 37%
Practitioner-DW/275	78,591	14,441,029	0 01%	156,886	0 01%	1,042,143,630	0 04%
Compound/Maint	1,286	2,521,190	0 00%	581,802	0 04%	2,119,819,133	0 08%
Other*	162,819	23,678,110	0 02%	279,668	0 02%	543,556,806	0 02%
Total	425,095,795	135,825,061,899	100.00%	1,388,516,901	100.00%	2,746,056,062,295	100.00%

* Each of the following Buyer Business Activities account for 0 01% or less of Dosage Units, Calculated Base Weight, and MME: Automated Dispensing System, Canine Handler, Chain Hosp/Clinic, Compound/Detox, Detoxification, MLP-Ambulance Service, MLP-Animal Shelter, MLP-Dept of State, MLP-Euthanasia Technician, MLP-Military, MLP-Naturopathic Physician, MLP-Nurse Practitioner, MLP-Nurse Practitioner-DW/30, MLP-Nurse Practitioner-DW/100, MLP-Optometrist, MLP-Physician Assistant, MLP-Physician Assistant-DW/30, MLP-Physician Assistant-DW/100, MLP-Registered Pharmacist, Pharmacy-Mil, Practitioner-Military, and Teaching Institution

62. The distribution of transactions reported in the ARCOS Data by the Buyer's State is presented in Table 9. Dispensers in California received the most Dosage Units, Calculated Base Weight in Grams and MME of any state, followed by Texas, Florida, New York, Pennsylvania and Ohio. These six states account for a little more than 36% of the opioid shipments by Dosage Units, by Calculated Base Weight in Grams and by MME.

63. States at the top of Table 9 are also the most populous states so the last two columns list the average and ranking by MME per capita over the 2006-2014 period. I have highlighted in bold the top 10 states by Annual MME per capita from 2006-2014.

Table 9 Transactions by Buyer's State

Buyer State	Transactions	Dosage Units	%	Calculated Base Weight	%	MME	%	Annual MME per Capita	MME Per Capita Rank
California	34,116,345	14,265,132,224	10.50%	144,147,037	10.38%	246,864,541,563	8.99%	734.9	44
Florida	27,628,426	9,099,330,210	6.70%	118,357,248	8.52%	226,144,996,345	8.24%	1,326.5	10
Texas	27,614,019	8,737,945,396	6.43%	71,856,185	5.18%	129,487,655,984	4.72%	571.2	48
Tennessee	13,686,994	5,993,947,214	4.41%	57,448,467	4.14%	102,641,656,039	3.74%	1,799.1	1
New York	20,740,851	5,966,272,302	4.39%	73,009,828	5.26%	172,892,443,895	6.30%	989.1	28
Ohio	17,247,523	5,806,655,796	4.28%	54,538,260	3.93%	111,222,452,069	4.05%	1,071.3	23
Pennsylvania	19,606,575	5,665,746,405	4.17%	64,932,734	4.68%	148,534,872,482	5.41%	1,301.3	13
Michigan	15,665,617	5,094,496,732	3.75%	50,508,260	3.64%	91,323,801,371	3.33%	1,022.2	25
North Carolina	15,654,076	4,441,013,844	3.27%	42,677,459	3.07%	87,372,100,437	3.18%	1,021.0	26
Illinois	12,612,003	3,823,214,843	2.81%	34,861,504	2.51%	67,936,505,921	2.47%	589.5	47
Georgia	14,464,310	3,802,194,109	2.80%	37,640,793	2.71%	75,391,358,665	2.75%	865.3	36
Indiana	10,773,851	3,521,917,055	2.59%	31,448,358	2.26%	64,109,285,889	2.33%	1,099.7	21
Washington	10,156,644	3,498,898,375	2.58%	32,581,129	2.35%	65,420,242,836	2.38%	1,080.9	22
Arizona	9,178,310	3,273,706,576	2.41%	37,735,956	2.72%	64,285,967,929	2.34%	1,116.9	19
Alabama	9,959,358	2,963,633,101	2.18%	28,990,594	2.09%	57,270,835,531	2.09%	1,336.7	9
South Carolina	7,416,518	2,956,556,366	2.18%	25,838,500	1.86%	40,865,381,018	1.49%	983.8	30
Kentucky	8,671,161	2,947,906,562	2.17%	24,361,382	1.75%	52,374,434,100	1.91%	1,343.2	7
Missouri	10,022,961	2,941,804,636	2.17%	28,621,758	2.06%	51,080,051,512	1.86%	950.4	31
Virginia	10,171,929	2,872,487,719	2.11%	27,961,583	2.01%	56,413,488,176	2.05%	782.6	41
New Jersey	10,342,159	2,589,817,832	1.91%	36,888,703	2.66%	83,481,448,018	3.04%	1,054.1	24
Oregon	6,501,855	2,456,823,189	1.81%	23,192,996	1.67%	45,160,716,051	1.64%	1,311.0	11
Massachusetts	7,058,475	2,379,990,293	1.75%	26,492,427	1.91%	71,981,327,783	2.62%	1,217.3	17
Oklahoma	7,754,529	2,347,961,706	1.73%	23,800,260	1.71%	41,501,551,598	1.51%	1,231.5	16
Wisconsin	8,457,886	2,278,805,560	1.68%	22,941,012	1.65%	45,620,840,529	1.66%	892.7	35
Louisiana	7,758,253	2,227,529,349	1.64%	21,955,349	1.58%	46,554,530,799	1.70%	1,146.6	18
Maryland	7,629,534	2,146,560,799	1.58%	28,424,966	2.05%	66,106,984,483	2.41%	1,268.3	14
Nevada	4,039,930	2,143,345,688	1.58%	20,389,639	1.47%	32,505,416,537	1.18%	1,340.2	8
Colorado	7,121,903	2,050,906,201	1.51%	19,449,200	1.40%	36,614,699,322	1.33%	807.5	39
Arkansas	5,716,135	1,570,116,921	1.16%	15,005,209	1.08%	24,092,530,804	0.88%	920.5	33
Minnesota	5,782,242	1,535,649,700	1.13%	13,896,692	1.00%	27,168,699,232	0.99%	568.4	49
Kansas	4,645,815	1,446,151,301	1.06%	12,814,722	0.92%	22,137,306,013	0.81%	865.0	37
Mississippi	5,351,588	1,386,176,032	1.02%	12,141,217	0.87%	23,801,384,700	0.87%	893.2	34
West Virginia	4,032,495	1,374,953,247	1.01%	12,756,235	0.92%	27,710,480,517	1.01%	1,667.8	3
Connecticut	4,679,646	1,219,237,554	0.90%	16,840,541	1.21%	42,067,293,465	1.53%	1,309.5	12
Utah	4,648,363	1,191,841,154	0.88%	13,030,889	0.94%	27,531,764,590	1.00%	1,110.5	20
Iowa	4,138,446	994,351,152	0.73%	8,270,308	0.60%	15,032,797,129	0.55%	548.3	50
New Mexico	2,714,819	919,096,920	0.68%	9,352,637	0.67%	17,477,821,530	0.64%	950.2	32
Maine	2,289,289	702,600,065	0.52%	7,765,542	0.56%	20,820,594,825	0.76%	1,742.1	2
Idaho	2,417,843	695,476,072	0.51%	6,187,731	0.45%	11,836,474,073	0.43%	842.3	38
Nebraska	2,559,570	547,121,781	0.40%	4,695,675	0.34%	8,469,741,825	0.31%	515.2	51
New Hampshire	2,011,289	509,797,959	0.38%	5,997,523	0.43%	14,809,345,496	0.54%	1,248.7	15
Montana	1,929,339	485,957,713	0.36%	4,703,802	0.34%	8,888,624,223	0.32%	998.7	27
Delaware	1,462,882	467,147,993	0.34%	6,165,846	0.44%	12,411,013,365	0.45%	1,533.9	4
Hawaii	1,267,488	446,244,115	0.33%	5,130,595	0.37%	9,034,756,341	0.33%	736.6	43
Rhode Island	1,348,121	423,647,440	0.31%	5,161,088	0.37%	13,262,708,605	0.48%	1,396.9	6
Alaska	983,607	303,646,336	0.22%	3,094,359	0.22%	6,309,325,701	0.23%	988.5	29
South Dakota	1,112,368	277,677,404	0.20%	2,590,992	0.19%	5,922,943,340	0.22%	806.4	40
Vermont	1,021,829	262,308,022	0.19%	2,682,428	0.19%	8,365,302,057	0.30%	1,487.2	5
Wyoming	960,004	238,165,303	0.18%	2,128,620	0.15%	3,870,354,803	0.14%	768.3	42
North Dakota	937,630	213,406,437	0.16%	1,901,186	0.14%	3,677,539,067	0.13%	598.3	46
Puerto Rico	599,845	148,776,227	0.11%	2,761,437	0.20%	5,847,237,904	0.21%	175.8	52
District of Columbia	381,866	145,978,288	0.11%	2,061,012	0.15%	3,980,538,365	0.14%	725.1	45
Other*	51,281	24,936,682	0.02%	329,027	0.02%	369,897,445	0.01%	n/a	n/a
Total	425,095,795	135,825,061,899	100.00%	1,388,516,901	100.00%	2,746,056,062,295	100.00%		

* Each of the following Buyer States account for 0.01% or less of Dosage Units, Calculated Base Weight, and MME: American Samoa, Armed Forces-Americas, Armed Forces-Europe, Armed Forces-Pacific, Guam, Northern Mariana Islands, Palau, and US Virgin Islands

64. The distribution of shipments to Dispensers reported in the ARCOS Data by year is presented in Table 10. The number of transactions, Dosage Units, Calculated Base Weight in Grams and MME all increased between 40% and 50% from 2006 to 2011.

Table 10 Transactions by Year

Year	Transactions	Dosage Units	Dosage Units %	Calculated Base Weight	Calculated Weight %	MME	MME %
2006	39,640,371	11,758,226,057	8.66%	122,967,270	8.86%	228,593,035,225	8.32%
2007	43,276,897	13,057,305,067	9.61%	134,106,656	9.66%	256,781,611,166	9.35%
2008	44,334,313	14,177,008,445	10.44%	143,699,519	10.35%	273,140,485,634	9.95%
2009	45,570,934	15,176,225,960	11.17%	154,797,658	11.15%	298,728,721,516	10.88%
2010	48,084,067	15,984,625,900	11.77%	166,304,307	11.98%	326,157,471,113	11.88%
2011	51,125,763	16,983,108,979	12.50%	173,428,942	12.49%	339,745,864,006	12.37%
2012	51,977,009	16,855,028,616	12.41%	171,268,738	12.33%	342,903,205,318	12.49%
2013	52,326,565	16,152,610,114	11.89%	162,705,625	11.72%	338,484,845,910	12.33%
2014	48,759,876	15,680,922,761	11.54%	159,238,186	11.47%	341,520,822,406	12.44%
Total	425,095,795	135,825,061,899	100.00%	1,388,516,901	100.00%	2,746,056,062,295	100.00%

VI. Comparing ARCOS Data to Retail Drug Summary Reports and to Defendant Transaction Data

A. Public ARCOS data

65. The DEA publishes six ARCOS Retail Drug Summary Reports (“RDSR”) each year, which summarize the weight of opioids reported in ARCOS transactions by various combinations of Drug Code, Calendar Quarter, Buyer State, Buyer Zip Code, or Buyer’s business activity.²⁶ The least aggregated Retail Drug Summary Report is Report 1, which aggregates the opioid weight by quadruples of Drug Code, Calendar Quarter, Buyer’s State, and the first three digits of the Buyer’s Zip Code. As a check on my procedures for correcting the ARCOS Data, I compared the corrected ARCOS Data to ARCOS Retail Drug Summary Report 1.

²⁶ The six summary reports are updated on an ad hoc basis. The DEA website states that the summary reports are “susceptible to future updates and corrections, without notice, as new information is obtained” (www.deadiversion.usdoj.gov/arcos/retail_drug_summary/index.html).

66. I calculated the total Calculated Base Weight in Grams in the corrected ARCOS Data for each Drug Code, Calendar Quarter, Buyer's State, and three-digit Buyer's Zip Code. I then compared the weights I calculated to the weights reported in ARCOS Retail Drug Summary Report 1.²⁷

67. There are 409,061 Drug Code/Calendar Quarter/State/3-digit zip code quadruples in either the ARCOS Data or the RDSR dataset. 408,389 of these observations are in both datasets, 457 are only in the ARCOS Data and 215 are only in the RDSR data. See Table 11.

68. The 457 observations that are in the ARCOS Data but not in the RDSRs have a total Calculated Base Weight in Grams of 217,068 grams. 216,544 grams (99.8%) of the 217,068 grams are from zip code 851** in Arizona.²⁸ The RDSRs do not report any weights for zip code 8541** in 2006 and 2007, even though there are shipments to Buyers in this zip code in 2006 and 2007 in the ARCOS Data and the RDSRs closely match the ARCOS data for 851** after 2007. Other than the observations Retail Drug Summary Report 1 is missing for zip code 851** in 2006 and 2007, only 3,231 grams are in observations where there is not some data in both the ARCOS Data and RDSRs out of 1.4 billion grams.

²⁷ I compared the weights for all quadruples created using all 14 Drug Codes in the ARCOS Data, every calendar quarter from 2006 through 2014, and all 50 states, the District of Columbia, Puerto Rico, American Samoa, and the Virgin Islands.

²⁸ 109 of the 457 transactions are from zip code 851** in Arizona.

Table 11 Comparison Corrected ARCOS Data and RDSR.

Drug Code	Drug Code/Quarter/State/ 3-digit Zip Codes in Both Datasets			Drug Code/Quarter/State/ Zip Codes in ARCOS Only		Drug Code/Quarter/State/ Zip Codes in RDSR Only	
	N	Weight of Base Drug (ARCOS)	Weight of Base Drug (RDSR)	N	Weight of Base Drug	N	Weight of Base Drug
9780	21,175	27,832,183	27,836,251	0	0	1	8
9220L	13,821	17,098	16,555	26	64	27	20
9639	30,138	312,322	5,549,118	11	21	34	81
9064	31,923	13,056,340	12,949,923	34	403	5	6
9801	32,116	4,383,862	4,266,080	12	501	12	7
9652	31,287	11,059,802	10,638,657	12	583	13	46
9120	23,214	755,277	746,160	299	590	42	69
9150	32,042	12,838,084	12,899,632	8	930	6	8
9230	32,049	22,785,269	23,105,649	11	4,407	11	147
9050	32,155	140,440,556	149,474,318	8	24,695	13	138
9250B	32,075	133,963,921	134,698,794	8	11,505	9	78
9193	32,164	337,565,862	340,741,300	10	41,620	16	1,342
9300	32,111	195,236,784	195,377,422	10	54,031	13	456
9143	32,119	489,503,746	490,414,951	8	77,718	13	302
Total	408,389	1,389,751,107	1,408,714,811	457	217,068	215	2,707

69. It is possible that both the ARCOS Data and the RDSRs have drug weights but the weights differ between the ARCOS Data and the RDSRs data. To test this possibility, I calculate the ratio of the weight of each drug, each quarter, each state and 3-digit zip code reported in the RDSRs to the weights I calculated from the ARCOS transactions for the observations in both the RDSRs and the ARCOS transactions. A ratio of 1 (less than 1, more than 1) means the RDSRs summary weights equal (are less than, are more than) the weights I aggregate up to using the ARCOS transaction data.

70. Table 12 reports the results of this test of the ARCOS Data. 270,300 or 66.2% of the 408,389 Drug Code/Quarter/State/3-digit zip code quadruples observations in both ARCOS and the RDSRs have ratios between 0.995 and 1.005. That is, $2/3^{\text{rds}}$ of the observations have RDSRs reported summary weights within 0.5% of the weights I aggregate up from the ARCOS transaction data. 72.4% of the observations have RDSRs reported summary

weights within 1.0% of the weights I aggregate up from the processed ARCOS transaction data.

71. The RDSRs confirm the accuracy of the ARCOS Data I received. The correlation between the RDSRs' reported drug weight and the weights I calculate from the ARCOS Data is **0.999** on a scale from -1.00 to +1.00.

Table 12 Ratios of Retail Drug Summary Report and ARCOS Drug Weights

Drug Code	N	N(%)	1st Percentile	5th Percentile	25th Percentile	50th Percentile	75th Percentile	95th Percentile	99th Percentile
9050	32,155	7.9%	0.97	1.01	1.04	1.07	1.11	1.20	1.32
9064	31,923	7.8%	0.76	0.92	1.00	1.00	1.00	1.02	1.09
9120	23,214	5.7%	0.00	0.71	1.00	1.00	1.00	1.01	1.19
9143	32,119	7.9%	0.90	0.97	1.00	1.00	1.00	1.02	1.11
9150	32,042	7.8%	0.82	0.97	1.00	1.00	1.00	1.03	1.28
9193	32,164	7.9%	0.89	0.98	1.00	1.00	1.00	1.04	1.35
9220L	13,821	3.4%	0.93	0.93	0.99	1.00	1.00	1.03	1.03
9230	32,049	7.8%	0.89	0.98	1.00	1.00	1.01	1.12	1.37
9250B	32,075	7.9%	0.86	0.99	1.00	1.00	1.00	1.02	1.30
9300	32,111	7.9%	0.88	0.98	1.00	1.00	1.00	1.03	1.17
9639	30,138	7.4%	0.91	1.00	1.00	1.00	1.00	1.00	1.06
9652	31,287	7.7%	0.75	0.94	1.00	1.00	1.00	1.00	1.10
9780	21,175	5.2%	0.93	1.00	1.00	1.00	1.00	1.00	1.07
9801	32,116	7.9%	0.84	0.95	0.98	1.00	1.00	1.06	1.31
Total	408,389	100.0%	0.81	0.96	1.00	1.00	1.00	1.09	1.24

B. Defendants' Transaction Data

72. In addition to receiving the ARCOS Data produced by the DEA, I received transaction data produced in discovery by 13 Defendants.²⁹ I

²⁹ The 13 Defendants are Anda, AmerisourceBergen, Cardinal Health, CVS, Discount Drug Mart, HBC, Henry Schein, H. D. Smith, McKesson, Prescription Supply, Rite Aid, Walgreens, and Walmart. I do not discuss the data produced by Rite Aid or Henry Schein because the produced data was insufficient to compare with the ARCOS Data. Rite Aid did not produce the Buyer's DEA numbers, and the data produced by Rite Aid does not identify which counties are included in the data. Henry Schein did not include the Buyer's DEA numbers or NDCs. Appendix 7 lists the data fields provided by each Defendant. I have standardized the names of the fields to simplify the presentation.

analyzed the Defendants' internal data and found that there are gaps in the data produced by some Defendants; with the exception of AmerisourceBergen these gaps are relatively minor.³⁰ I compared each transaction in each Defendant's internal data to the ARCOS Data. I matched the transactions based on NDC, Buyer's DEA Number, Quantity, and the calendar month. After matching the transactions, I converted the transaction Quantity to MME.

73. Table 13 presents summary statistics comparing the ARCOS Data and the Defendants' transaction data, sorted by the degree of overlap between the ARCOS Data and the Defendants' transaction data. The transactions summarized in Table 13 consist of all transactions by the Defendants with retail Buyers in Cuyahoga and Summit Counties from January 1, 2006 through December 31, 2014, involving the 14 opioids in Table 1.³¹

74. At first glance it appears that there is significant non-overlap between the data the Defendants produced to ARCOS in real time, which the DEA then produced, and the data the Defendants produced in discovery but after making some minor adjustments the non-overlap is quite small.

³⁰ For example, Rite Aid only produced transactions for 2007, and only for hydrocodone (9193). Henry Schein produced only 67 transactions for 2006 through 2014.

³¹ I keep only transactions involving NDCs on Schedule II and III.

Table 13 Overlap between ARCOS Data and Defendant Data

Defendant	Transactions in Both Datasets			Transactions Only in ARCOS			Transactions Only in Defendants		
	N	MME	MME (%)	N	MME	MME (%)	N	MME	MME (%)
Cardinal Health	544,054	3,710,172,198	99.2%	1,397	2,347,131	0.1%	11,388	27,957,628	0.7%
AmerisourceBergen	420,974	2,759,799,395	84.4%	60,750	467,226,119	14.3%	19,451	42,932,581	1.3%
McKesson	423,952	2,360,097,033	89.7%	39,318	140,948,298	5.4%	31,182	128,686,406	4.9%
Walgreens	319,997	1,406,211,786	83.9%	36,337	257,764,538	15.4%	1,963	11,825,732	0.7%
CVS	113,342	223,193,105	38.7%	34,083	334,248,179	57.9%	11,317	19,815,640	3.4%
Anda	6,217	81,340,894	66.1%	1,475	41,640,416	33.8%	25	68,932	0.1%
HD Smith	10,606	80,568,759	95.4%	527	2,181,492	2.6%	375	1,672,837	2.0%
Walmart	41,890	79,487,906	59.2%	20,729	50,122,079	37.3%	1,324	4,684,806	3.5%
HBC	68,181	67,162,504	83.6%	6,940	10,749,410	13.4%	2,462	2,421,062	3.0%
Discount Drug Mart	31,602	58,974,937	93.8%	25	54,269	0.1%	1,941	3,862,765	6.1%
Prescription Supply	8,596	39,700,220	58.6%	5,122	28,066,884	41.4%	32	2,853	0.0%
Total	1,989,411	10,866,708,738	87.3%	206,703	1,335,348,814	10.7%	81,460	243,931,242	2.0%

75. Using my initial matching criteria, 87.3% of all MME in either the ARCOS Data or the datasets produced by Defendants are in both the ARCOS Data and the datasets produced by Defendants (i.e., the MME are in the intersection of the ARCOS Data and the datasets produced by Defendants).

76. The amount of MME found in both the ARCOS Data and the datasets produced by Defendants increases if I relax the stringent matching rules I imposed. As discussed more fully below, allowing matches to cross to an adjacent month increases the MME found in both the ARCOS Data and the datasets produced by Defendants by 98.0 million MME. Correcting Buyer information (e.g., DEA numbers and county) increases the MME in both the ARCOS Data and the datasets produced by Defendants by an additional 24.1 million MME.

77. The remainder of this section of the report includes a more detailed explanation of the MME that is either (1) in the ARCOS data but not in the datasets produced by Defendants, or (2) in the datasets produced by Defendants but not in the ARCOS Data for each Defendant listed in Table 13.

78. Excluding AmerisourceBergen, I can explain 95% of the 1.1 billion MME in Table 13 that is either (1) in the ARCOS Data but not in the datasets produced by Defendants, or (2) in the datasets produced by Defendants but not in the ARCOS Data.

79. For example, the ARCOS Data includes at least 613 million MME that are not in the datasets produced by Defendants because the datasets produced by Defendants are missing all transactions for some NDCs. The ARCOS Data also includes an additional 65 million MME that are not in the datasets produced by Defendants because the datasets produced by Defendants are missing all transactions for some calendar months.

80. Table 14 summarizes the overlap between the ARCOS Data and the datasets produced by Defendants after (1) allowing matches to cross to an adjacent calendar month and correcting Buyer information, and (2) excluding NDCs, Buyers, months, and reversed transactions that are entirely missing from either the ARCOS data or the datasets produced by the Defendants. Excluding AmerisourceBergen, **99.5%** of MME in either the ARCOS Data or the datasets produced by Defendants are in both the ARCOS Data and the datasets produced by Defendants.

Table 14 Overlap between ARCOS data and Defendant Data, allowing expanded matching and excluding known non-overlaps in the datasets

Defendant	Transactions in Both Datasets			Transactions Only in ARCOS			Transactions Only in Defendants		
	N	MME	MME (%)	N	MME	MME (%)	N	MME	MME (%)
Cardinal Health	544,231	3,709,925,916	99.9%	1,194	2,542,334	0.1%	4,775	1,131,973	0.0%
AmerisourceBergen	420,974	2,759,799,395	84.5%	59,799	464,163,248	14.2%	19,004	42,785,600	1.3%
McKesson	442,674	2,477,206,801	99.2%	2,477	9,740,581	0.4%	3,805	10,922,817	0.4%
Walgreens	319,997	1,406,211,786	99.2%	0	0	0.0%	1,963	11,825,732	0.8%
CVS	121,821	239,645,380	98.4%	396	654,112	0.3%	2,838	3,363,366	1.4%
Anda	6,219	81,344,677	99.5%	168	378,973	0.5%	23	65,148	0.1%
HD Smith	10,648	81,018,247	98.7%	12	28,106	0.0%	277	1,063,501	1.3%
Walmart	41,890	79,487,906	94.4%	69	38,881	0.0%	1,323	4,682,130	5.6%
HBC	69,325	68,161,943	95.3%	1,378	1,920,556	2.7%	1,318	1,421,623	2.0%
Discount Drug Mart	31,602	58,974,937	98.9%	25	54,269	0.1%	101	612,118	1.0%
Prescription Supply	8,596	39,700,220	99.8%	11	90,345	0.2%	32	2,853	0.0%
Total	2,017,977	11,001,477,209	95.2%	65,529	479,611,405	4.1%	35,459	77,876,861	0.7%

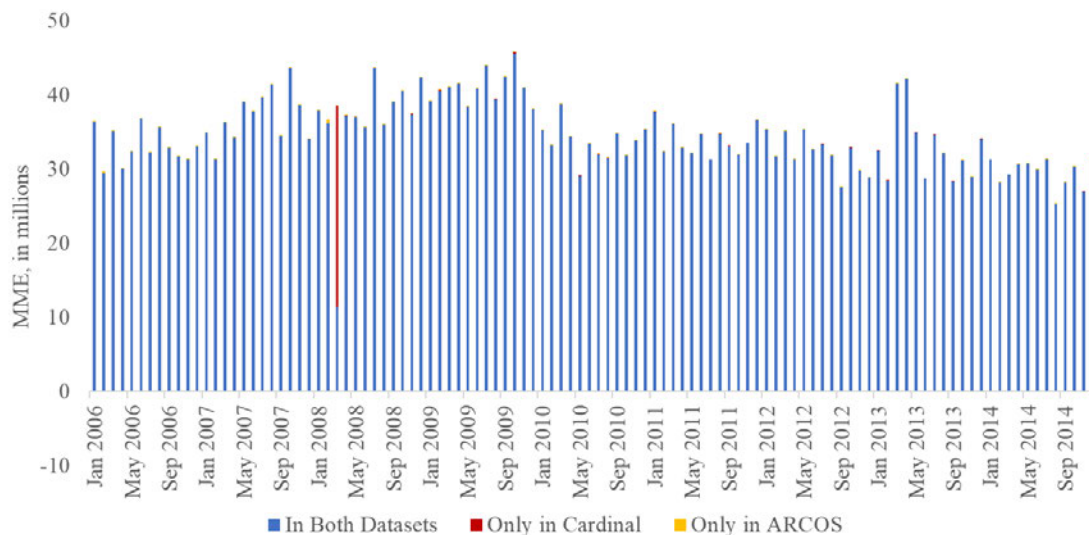
81. The 99.5% overlap between the ARCOS Data and the datasets produced by Defendants demonstrates that the ARCOS Data and the datasets produced by Defendants in discovery are both reliable. The remainder of this section explains the relatively slight differences, setting aside AmerisourceBergen, between the ARCOS Data and the Defendants' data.

1. Cardinal Health

82. Figure 2 shows the MME reported each month in the ARCOS Data or in Cardinal Health's internal data.

- The blue areas on each bar in the chart indicate MME in transactions where the transactions are reported in both the ARCOS Data and in the Cardinal Health transaction data.
- The red areas represent the MME in Cardinal Health's transactions that were not matched to transactions in the ARCOS data.
- The yellow areas represent the MME in ARCOS Data transactions that were not matched to transactions in Cardinal Health's transaction data.

Figure 2 MME Reported in the ARCOS Data or Cardinal Health Transactions, January 2006 through December 2014



83. Virtually all of the transactions in Cardinal Health's data and the transactions in the ARCOS Data match, with the exception of March 2008, when the ARCOS Data appears to be missing much of Cardinal Health's transactions. There are no Cardinal Health shipments to Buyers in Cuyahoga and Summit Counties in the ARCOS Data produced by the DEA for 21 consecutive days in March 2008, when Cardinal Health's transactions data produced in discovery include substantial shipments. The otherwise nearly perfect overlap of the ARCOS Data and the Cardinal Health transaction data suggests that both are accurate and complete although the ARCOS Data should be supplemented with March 2008 Cardinal Health transactions produced in discovery.³²

84. Other very minor differences between Cardinal Health's transactions data and the ARCOS Data include transactions that Cardinal Health reversed on the same day it recorded them in its own system and never reported the offsetting pairs of transactions to ARCOS. These transactions have zero net MME. Cardinal Health produced those offsetting entries in discovery even though they don't reflect executed transactions and Cardinal Health apparently did not report the offsetting transaction to the ARCOS system in real time. Also, some transactions with Transaction Dates in one month in the ARCOS Data were reported in an adjacent month in Cardinal Health's internal transaction data.

85. Table 15 summarizes the results of matching ARCOS Data and Cardinal Health data, excluding transactions in March 2008 and transactions

³² In my calculation below I insert these missing March 2008 transactions Cardinal Health produced in discovery into the ARCOS Data.

that Cardinal Health reversed on the same day it recorded them in its own system and never reported to ARCOS and allowing matches to cross calendar months. **99.9%** of the MME reported in transactions in either the ARCOS data or Cardinal Health data are reported in both the ARCOS Data and Cardinal Health data.

86. A few NDCs account for the majority of the 0.1% of total Cardinal Health MME that are in Cardinal Health's transaction data but not in the ARCOS Data. For example, more than 605,000 MME of the 622,336 MME not found in the ARCOS Data for Drug Code 9050 (codeine) are in six NDCs. All six NDCs are capsules or tablets containing a combination of codeine, butalbital, and caffeine. Similarly, 258,887 MME (96.5%) of the 265,909 MME in Drug Code 9150 (hydromorphone) that I did not find in ARCOS are from transactions involving one NDC of liquid hydromorphone in October 2009.

Table 15 Comparison of Transactions Reported in ARCOS Data vs. Cardinal Health data, Excluding March 2008 and Allowing Expanded Matching

Drug Code	Transactions in Both Datasets		Transactions Only in ARCOS		Transactions Only in Cardinal	
	N	MME	N	MME	N	MME
9143	201,057	1,381,748,715	24	181,877	567	87,476
9193	83,377	99,467,608	7	-15,740	128	15,757
9801	70,951	770,967,743	13	369,500	309	49,725
9300	65,189	330,991,402	1,126	1,784,137	299	1,661
9064	38,311	622,457,578	4	-158,062	14	-6,862
9150	20,762	100,512,963	4	65,254	56	265,909
9250B	17,597	218,555,906	4	299,240	51	53,664
9050	13,939	12,569,072	4	1,849	1,751	622,336
9652	15,024	117,690,828	4	8,029	43	18,734
9230	7,465	6,085,756	0	0	35	23,291
9780	7,564	34,861,200	0	0	12	1,000
9639	1,223	2,122,920	0	0	0	0
9120	373	135,392	0	0	0	0
9220L	66	104,430	0	0	0	0
	542,898	3,698,271,515	1,190	2,536,084	3,265	1,132,691

2. AmerisourceBergen

87. AmerisourceBergen did not include Buyer DEA numbers in the data it produced and so I compared the ARCOS Data to AmerisourceBergen's transaction data using only the transaction month, Quantity, and NDC.

88. Nearly all the MME in the AmerisourceBergen transaction data (98.7%) is also found in transactions in ARCOS but AmerisourceBergen did not produce a large number of transactions in 2011 and 2012 reflected in the ARCOS Data; the transactions missing from AmerisourceBergen's transaction data is spread across a wide range of NDCs and Buyer DEA Numbers. See Figure 3 and Figure 4.

Figure 3 ARCOS Data and AmerisourceBergen Data, by Month

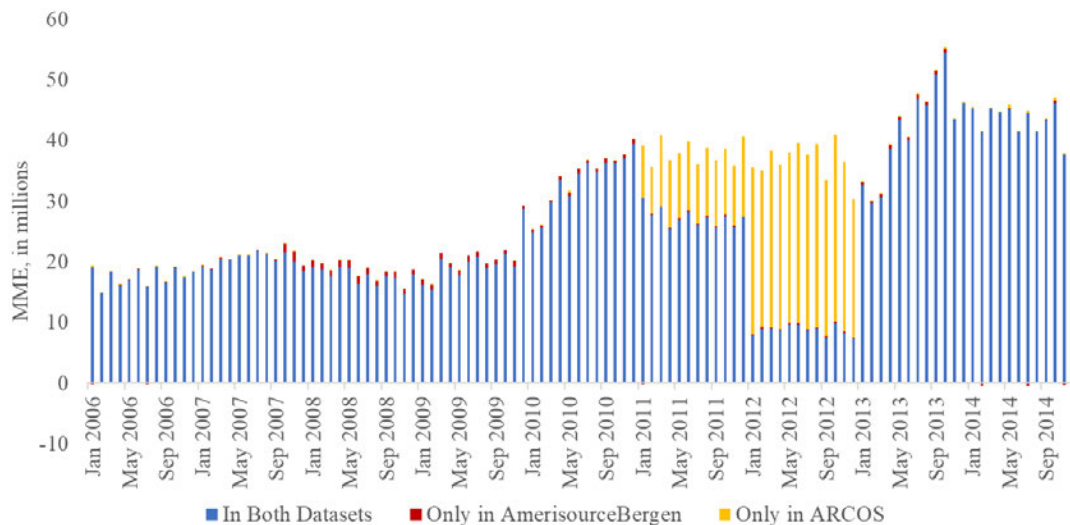
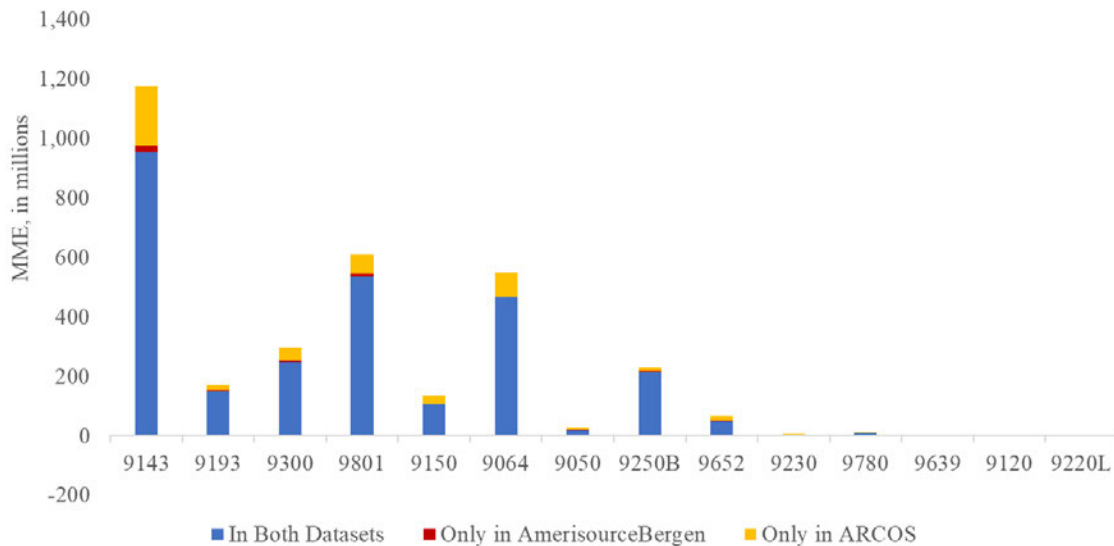


Figure 4 ARCOS Data and AmerisourceBergen Data, by Drug Code



3. McKesson

89. The mismatch between McKesson transaction data and the ARCOS Data reported in Table 13 is largely caused by the same transaction being reported with a different Transaction Date in the ARCOS Data than in the data McKesson produced in discovery. Allowing the McKesson transactions to match with ARCOS Data transactions in adjacent months increases the matched MME by 88.4 million (69% of McKesson's MME not in the ARCOS Data, and 63% of the AROCS MME not in McKesson).

90. The second-largest contributor to the mismatch between McKesson transaction data and the ARCOS Data is differences in Buyer information. McKesson's transaction data includes transactions with Buyers that the ARCOS Data did not classify as being in Summit or Cuyahoga County, and the ARCOS Data might include transactions that McKesson did not classify as being in Summit or Cuyahoga County. There are also transactions where the ARCOS Data and the McKesson data used different Buyer DEA numbers for the same VA hospital.

91. A relatively small number of McKesson data transactions (8,202) did not match the ARCOS Data because McKesson reversed the transactions on the same day it recorded them in its system and never reported them to ARCOS. These transactions have zero net MME.

92. After accounting for the differences in transaction dates and counties and correcting the mismatched Buyer DEA number, 99.2% of the MME reported in transactions in either the ARCOS Data or McKesson's transaction data are the same in both the ARCOS Data and in McKesson's data.

93. The McKesson data is missing all transactions involving 47 NDCs (14.0 million MME). 58% of the MME (8.1 million MME) are from three codeine NDCs.³³ The McKesson data is also missing all transactions with Buyers whose Business Activities in the ARCOS Data are "PRACTITIONER-DW/100" or "PRACTITIONER-DW/30", which accounts for 0.9 million MME.

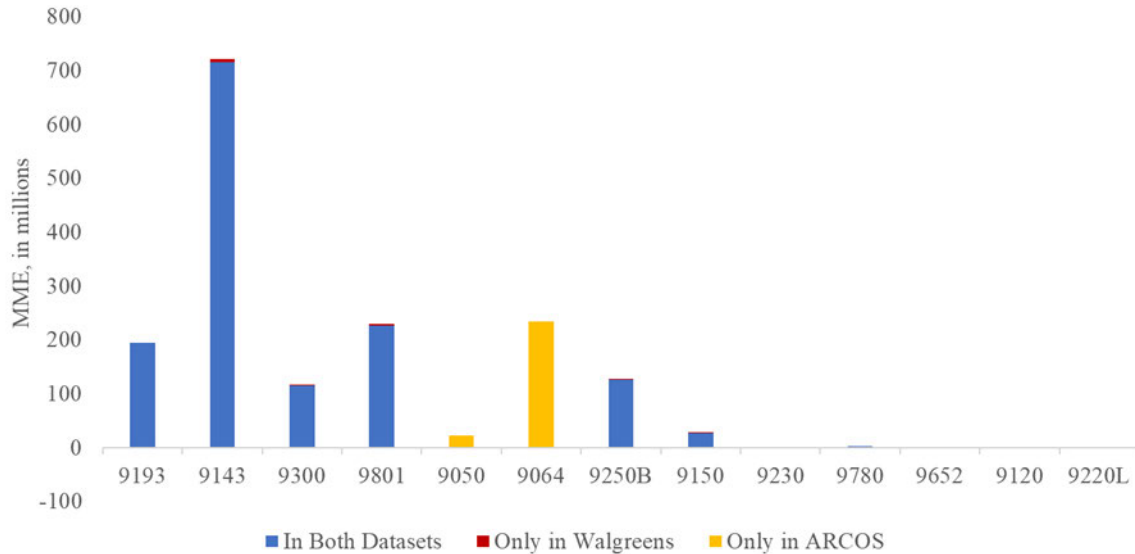
4. Walgreens

94. The MME in the ARCOS Data missing from Walgreens transaction data is explained by NDCs missing from the Walgreens transaction data. The Walgreens transaction data is missing all NDCs from

³³ The three codeine NDCs are: 00406048401 (3.1 million MME), 00093015010 (2.5 million MME), and 00093015001 (2.5 million MME). I include the McKesson transactions for these three NDCs and the small number of Buyer Business Activities with the ARCOS Data in my calculation below.

five Drug Codes: 9050 (codeine), 9064 (buprenorphine), 9230 (meperidine), 9120 (dihydrocodeine), and 9220L (levorphanol).³⁴ See Figure 5.

Figure 5 ARCOS Data and Walgreens Data

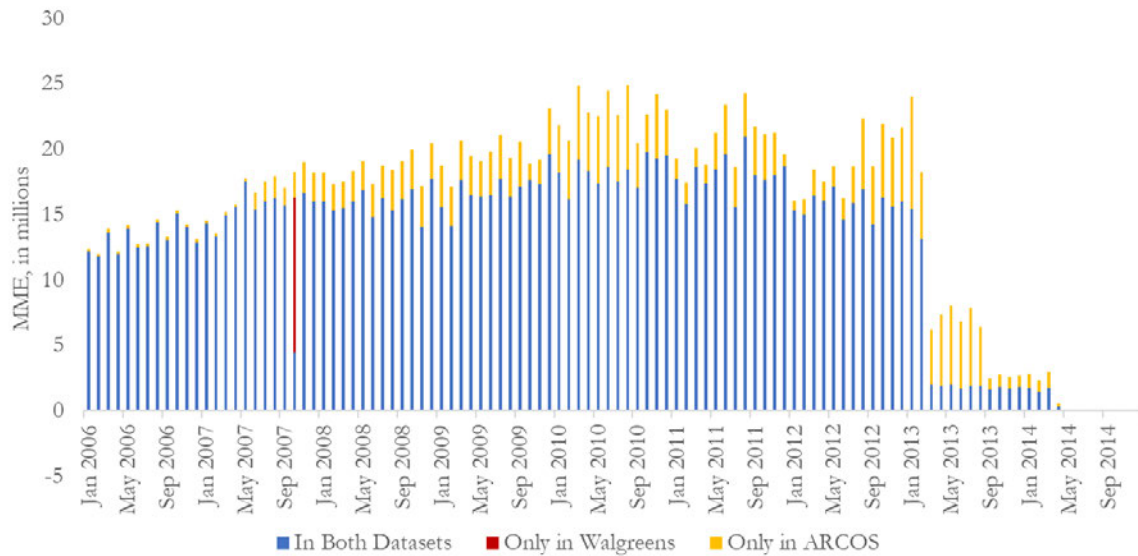


95. These five Drug Codes account for 258.1 million (100%) of the MME in the ARCOS Data missing from Walgreens data. Nearly all of the MME in those Drug Codes is from 9064 (buprenorphine, 90.9%) or 9050 (codeine, 8.8%).

96. The Walgreens data is also missing transactions where the Dispenser returned a cumulative 1.0 million MME to the Seller. All the MME in the Walgreens transaction data that is not in the ARCOS Data is in October 2007, suggesting the ARCOS Data might be missing some transaction reports. See red bar in Figure 6.

³⁴ There are 40 codeine NDCs, 22 buprenorphine NDCs, 5 meperidine NDCs, 11 dihydrocodeine NDCs, and 1 levorphanol NDC.

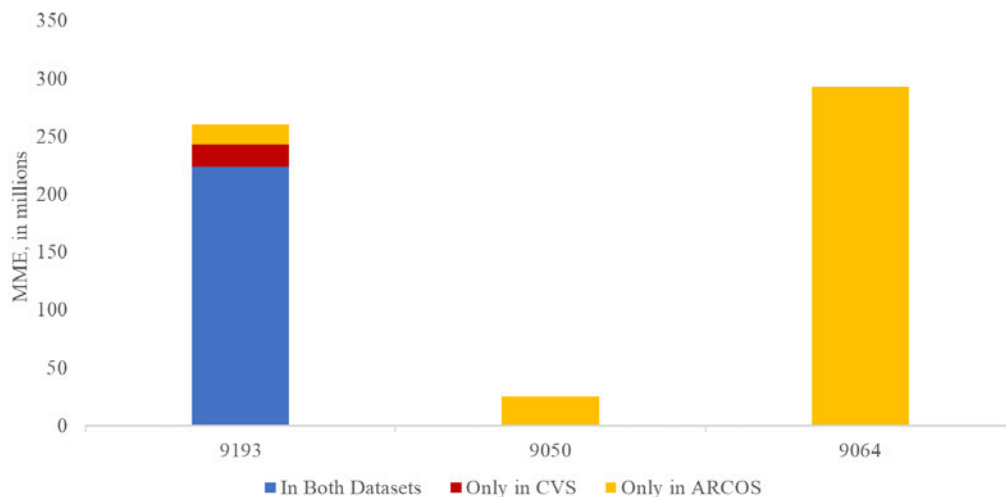
Figure 6 ARCOS Data and Walgreens Data, by Month



5. CVS

97. The CVS transaction data is missing all transactions in Drug Codes 9050 (codeine) and 9064 (buprenorphine). See Figure 7. This explains 317.3 million (95%) of the MME in the ARCOS Data that is missing from the CVS transaction data.

Figure 7 ARCOS Data and CVS Data



98. The majority of the MME in the CVS transactions data that is not in the ARCOS Data can be accounted for by allowing transactions to be

matched across calendar months and by correcting Buyer information. Allowing the CVS transactions to match with ARCOS Data transactions in adjacent months increased matched MME by 8.4 million (42% of the MME in the CVS data missing in the ARCOS Data, 3% of the MME in the ARCOS Data missing from the CVS data). Another 7.9 million MME (40% of the MME in the CVS data missing from the ARCOS Data, 2% of the MME in the ARCOS Data missing from the CVS data) can be matched by correcting Buyer DEA numbers. In January 2010, five CVS pharmacies were assigned new DEA numbers, but either CVS or the ARCOS Data continued to use the old DEA number.³⁵ 1% of the MME in the CVS data missing from the ARCOS Data is due to CVS including Buyers that the ARCOS Data locates outside Summit and Cuyahoga Counties.

6. Anda

99. 18.4 million (44%) of the MME in ARCOS transactions which is missing from Anda's transaction data is because Anda did not produce any transactions for Buyers whose Buyer Business Activity in the ARCOS Data is "PRACTITIONER-DW/100" or "PRACTITIONER-DW/275." Another 18.8 million (45%) of the ARCOS MME missing from Anda's transaction data is because Anda did not report transactions for one specific Buyer found

³⁵ The DEA numbers of the five Buyers are BC6576764 (changed to FO1802950), BC6668997 (changed to FO1802998), BC7023865 (changed to FO1803267), BC5772579 (changed to FO1803368), and BC5772632 (changed to FO1803407).

in the ARCOS Data before February 6, 2014, and only reported some of that Buyer's transactions after February 6, 2014.³⁶

100. Anda's transaction data is also missing all transactions involving buprenorphine (9064), and all transactions in 31 additional NDCs. The missing buprenorphine transactions account for 3.2 million (7.8%) of the MME in ARCOS missing from the Anda data.³⁷ The 31 additional NDCs account for another 0.8 million (2.0%) of the MME in the ARCOS Data missing from the Anda data.³⁸

7. H. D. Smith

101. Some of the mismatch between H. D. Smith transaction data and ARCOS Data is caused by the same transaction reported with a different Transaction Date in the ARCOS Data than the Transaction Date in the H. D. Smith transaction data. Allowing the H. D. Smith transactions and the ARCOS Data transactions to be matched across adjacent months increases the matched MME by 0.45 million (27% of H. D. Smith's MME not found in the ARCOS Data and 21% of the ARCOS MME not found in H. D. Smith's MME).

102. The remaining mismatch between the ARCOS Data and the H. D. Smith data is caused both by missing transactions in the H. D. Smith's data

³⁶ The Buyer DEA Number is FR3437856. After February 6, 2014, the Anda transaction data is missing all shipments of NDC 00093015010 (a codeine tablet) to that DEA number.

³⁷ There are 19 buprenorphine NDCs missing from Anda's data. The three largest buprenorphine NDCs by MME are: 50383093093 (1.9 million MME), 00228315503 (0.6 million MME), and 12496120803 (0.3 million MME).

³⁸ 99% of the 0.8 million MME from the 31 unmatched NDCs is codeine (9050).

and missing transactions in the ARCOS Data. The data produced by H. D. Smith is missing four Buyer DEA numbers, which together account for 1.4 million MME, or 66% of the MME in the ARCOS Data that is missing from the H. D. Smith data.³⁹ The H. D. Smith data is also missing nine NDCs, three of which account for 0.1 million MME, or 7% of the MME in the ARCOS Data that is missing from the H. D. Smith data.⁴⁰

103. The H. D. Smith data contains transactions in six NDCs that are not in ARCOS.⁴¹ The missing NDCs explain 0.2 million (10%) of the unmatched MME in the H. D. Smith data.

8. Walmart

104. The ARCOS Data shows substantial shipments by Walmart in 2006, 2007 and 2008 but the transactions produced in discovery by Walmart show no shipments in these three years. See Figure 8.

105. Walmart's data is also missing all transactions of all buprenorphine (9064) NDCs, and six codeine (9050) NDCs.⁴² The missing

³⁹ The three missing Buyer DEA numbers are AK2946854, AP4581155, BA5214159, and FE1824247.

⁴⁰ The nine missing NDCs are: codeine NDCs 00527131201 and 00591354601; oxycodone NDC 53746020601; hydrocodone NDCs 00591038701 and 00591261205; methadone NDC 00054355367; morphine NDCs 50383085516 and 66479056024; and oxymorphone NDC 63481044070. Of the nine NDCs, the three NDCs with the highest MME are morphine NDC 66479056024 (68,582 MME), methadone NDC 00054355367 (50,785 MME), and oxymorphone NDC 63481044070 (10,705 MME).

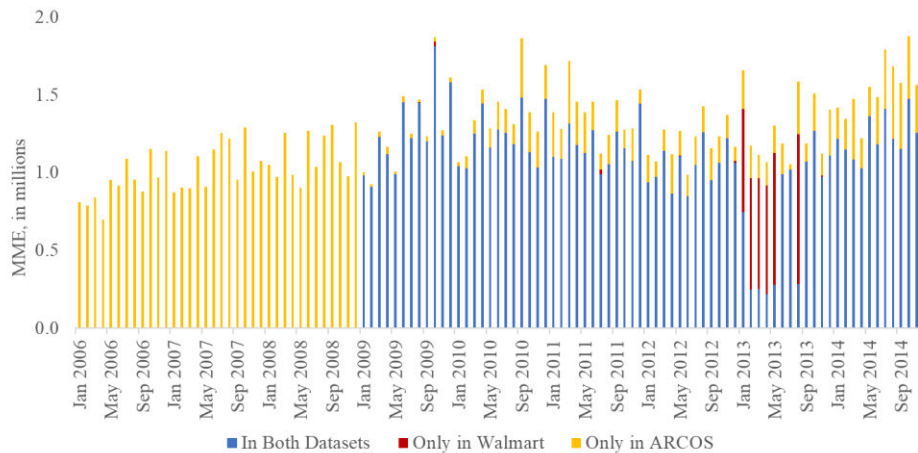
⁴¹ The six missing NDCs are: codeine NDC 00143300001; buprenorphine NDC 12496075701; hydrocodone NDCs 00406035701 and 00406035901; and fentanyl NDCs 49884076278 and 49884076378. I include the H.D. Smith transactions for these six NDCs with the ARCOS Data in my calculation below.

⁴² The Walmart data is missing five buprenorphine NDCs, with a total MME of 11.3 million. Of the five NDCs, the largest buprenorphine NDC by MME is 00054017713,

months and NDCs explain more than 99% of the MME in the ARCOS Data that is missing from the Walmart data.

106. 2.3 million (50%) MME in Walmart transactions that is not in ARCOS transactions is from two oxycodone NDCs.⁴³ The ARCOS Data is not missing those two NDCs entirely, as there are transactions with those NDCs in the ARCOS Data.

Figure 8 ARCOS Data and Walmart Data



107. There is a large amount of unmatched MME in 2013, with ARCOS Data transactions missing from Walmart transactions data and Walmart data transactions missing from the ARCOS Data. The missing MME

which accounts for 11.0 million of the unmatched MME in the ARCOS Data. The six codeine NDCs have a total MME of 1.9 million. They are: 00603233832 (1.1 million MME), 00093015010 (0.3 million MME), 00406048501 (0.2 million MME), 00603233921 (0.2 million MME), 00093035001 (0.1 million MME), and 00591354601 (0.02 million MME).

⁴³ The two oxycodone NDCs are 00406052301 (1.3 million MME) and 00406051201 (1.1 million MME).

in the ARCOS Data is from different Drug Names than the missing MME in Walmart's data.

9. HBC/Giant Eagle⁴⁴

108. The mismatch between HBC/Giant Eagle's data and the ARCOS Data has two major causes. First, HBC/Giant Eagle's transaction data does not include any transactions of Drug Codes 9064 (buprenorphine) or 9050 (codeine). The NDCs in these two Drug Codes account for 6.6 million (61%) of the MME in the ARCOS Data that is missing from HBC/Giant Eagle's data.

109. Second, some transactions are reported with different a Transaction Date in the ARCOS Data than in the data HBC/Giant Eagle produced in discovery. Allowing an HBC/Giant Eagle transaction to match an ARCOS Data transaction in an adjoining calendar month reduces the unmatched MME by 1.0 million (41% of the MME in HBC/Giant Eagle's data missing from the ARCOS Data and 9% of the MME in the ARCOS Data missing from HBC/Giant Eagle's data).

110. Another 1.3 million (12%) of MME from the ARCOS Data missing in the HBC/Giant Eagle data is in transactions with a Buyer that has addresses in both Cuyahoga and Geauga Counties. HBC/Giant Eagle may have not produced transactions for these buyers attributing the buyers to the address in Geauga County, outside of Summit and Cuyahoga Counties, even

⁴⁴ HBC produced transaction data from two different distribution facilities. For purposes of my analysis, I have included the data produced for both facilities, and refer to HBC transactions herein as HBC/Giant Eagle.

though the transactions were identified in the ARCOS Data as shipped to Cuyahoga County.

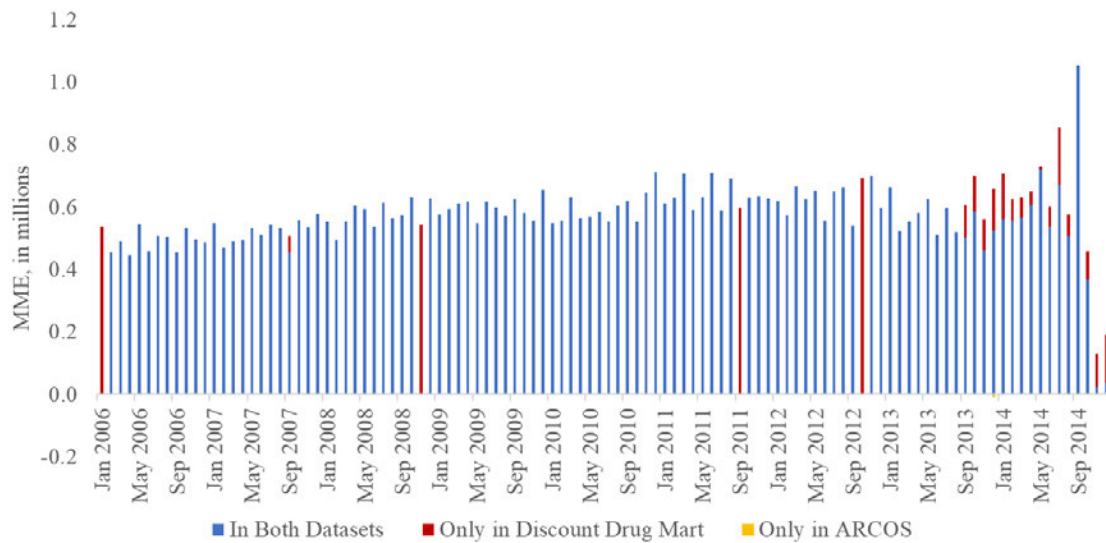
10. Discount Drug Mart

111. The ARCOS Data is missing all retail transactions by Discount Drug Mart in November 2008, September 2011, and October 2012 and missing all but two of Discount Drug Mart's transactions in January 2006. For most other months, the Discount Drug Mart transaction data produced in discovery perfectly matches the ARCOS Data transactions. See Figure 9.

112. The four missing months in the ARCOS Data explain 2.4 million (61%) of the MME in Discount Drug Mart's transaction data that is not in the ARCOS Data. Another 883,000 MME in Discount Drug Mart's transaction data are not in the ARCOS Data because the ARCOS Data I received is missing eight NDCs found in Discount Drug Mart's transaction data.⁴⁵

⁴⁵ The eight missing NDCs are: codeine NDCs 00093035001, 00093035005, 00603233921; buprenorphine NDC 59011075704; and hydrocodone NDCs 00591261001, 00591261101, 00603388721, and 64376064016. I include the DDM transactions produced in discovery but missing from the ARCOS Data for the four months and the eight NDCs with the ARCOS Data in my calculation below.

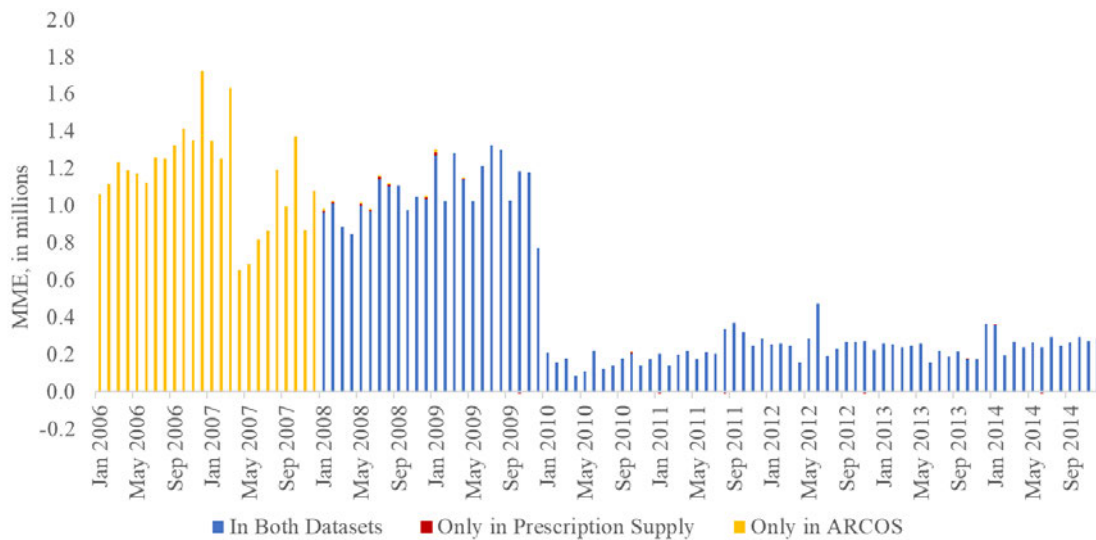
Figure 9 ARCOS Data and Discount Drug Mart Data



11. Prescription Supply

113. The ARCOS Data shows substantial shipments by Prescription Supply in 2006 and 2007, but Prescription Supply transactions data include no shipments in these two years. For the remaining seven years of data, the Prescription Supply transaction data produced in discovery almost perfectly matches the ARCOS Data transactions. See Figure 10.

Figure 10 ARCOS Data and Prescription Supply Data



VII. Supplementing the Data

114. I added several fields to the ARCOS Data to assist in my analysis. The fields are: drug Labeler names from the FDA, drug Labeler company families, Seller company families, drug product potency information from the CDC's Morphine Milligram Equivalents (MME) conversion table, and Buyer business activities from the Centers for Medicare and Medicaid Services.

A. Drug Labeler

115. The ARCOS Data includes the Seller name but not the Labeler name. As explained by the DEA, "A Labeler is any firm that manufacturers, distributes or repacks/relabels a drug product."⁴⁶ The Labeler is identified in the first segment of the NDC. The FDA, which assigns the Labeler identifier used in the NDC, maintains a public list of Labeler identifiers and their associated companies. I used the FDA's list of drug Labelers to add the names of the drug Labelers to the ARCOS Data.⁴⁷

116. After adding Labeler names, I manually reviewed the names and grouped them into company families. For example, I assigned "Teva Pharmaceuticals USA, Inc." and "Teva Parenteral Medicines, Inc." to the same "Teva" company family.⁴⁸

⁴⁶ NDC Dictionary Instructions. *See also*, ARCOS Handbook, §6.1.2.1, p. 6-2.

⁴⁷ NDC/NHRIC Labeler Codes," U.S. Food & Drug Administration. Available at www.fda.gov/ForIndustry/DataStandards/StructuredProductLabeling/ucm191017.htm.

⁴⁸ Appendix 5 lists all the labeler company families and the labelers I assigned to each company family. I also grouped the Seller's Names in the ARCOS Data into Seller company families. Appendix 6 also lists all the Seller company families and the Seller's Names I assigned to each Seller company family.

B. MME Conversion Factor

117. Because each drug can be prescribed in more than one dosage strength (e.g., 5 mg or 10 mg), compiling only the number of pills shipped provides a partial picture of the amount of drugs shipped. Also, since different drugs can have different potencies, compiling only the total weight of active ingredient shipped also provides a partial picture of the amount of drugs shipped.

118. The CDC has published “MME conversion factors” that allow opioids to be directly comparable to one another by converting different drugs and dosage strengths into morphine milligram equivalents.⁴⁹ I added the MME conversion factor to the ARCOS Data, matching the NDC in the CDC table to the NDC in the ARCOS Data.

C. Additional Pharmacy Information

119. I supplemented the Buyer Business Activity field with data from the Centers for Medicare and Medicaid Services, which assigns National Provider Identifiers (“NPIs”) to most covered health care providers in the United States. In addition to assigning and tracking NPIs, the Centers for Medicare and Medicaid Services provides a classification of Buyers’ Business Activities that is more detailed than the classification in the ARCOS Data,

⁴⁹ National Center for Injury Prevention and Control. CDC compilation of benzodiazepines, muscle relaxants, stimulants, zolpidem, and opioid analgesics with oral morphine milligram equivalent conversion factors, 2018 version. Atlanta, GA: Centers for Disease Control and Prevention; 2018. Available at www.cdc.gov/drugoverdose/resources/data.html.

allowing me to better identify mail-order pharmacies, long-term care pharmacies, and managed care pharmacies. I used the Buyer Name and Address in the ARCOS Data to look up each Buyer in the NPI database.⁵⁰ I used the NPI database to identify mail-order, long-term care and managed care pharmacies, but I otherwise relied on the Buyer Business Activity in the ARCOS Data.⁵¹

VIII. Cuyahoga County and Summit County ARCOS Data

A. Cuyahoga County

120. According to the ARCOS Data, between 2006 and 2014, Dispensers in Cuyahoga County received 8.55 billion MME of opioids. Given the County's average 1.28 million population⁵², Dispensers received enough opioids for every resident in the county to consume 742 MME every year from 2006 to 2014. Table 16 through Table 19 summarize the End User transactions reported in the ARCOS Data for Cuyahoga County.

121. According to the ARCOS Data, between 2006 and 2014, Dispensers in Cuyahoga County received 465.1 million Dosage Units of opioids. As shown in Table 16, oxycodone accounted for nearly half of all Dosage Units and 33% of MME in the county. Hydrocodone accounted for a large percentage of transactions and Dosage Units, but only 8.0% of total MME. Buprenorphine and fentanyl have a large MME relative to their Dosage

⁵⁰ NPI database.

⁵¹ The corrected and supplemented ARCOS data I used in the analysis that follows is being provided separately by Counsel.

⁵² <https://factfinder.census.gov/>

Units because both are prescribed as skin patches, which dispense the drug for up to one week.

Table 16 Transactions in Cuyahoga County, OH by Drug

Drug Name	# of Transactions	Dosage Units	Dosage Units %	MME	MME %
Oxycodone	430,565	219,366,212	47.16%	2,783,792,929	32.55%
Hydrocodone	481,786	169,012,014	36.34%	680,722,410	7.96%
Codeine	67,563	24,780,459	5.33%	96,411,936	1.13%
Morphine	124,517	16,809,425	3.61%	516,067,281	6.03%
Hydromorphone	46,003	6,127,328	1.32%	196,679,959	2.30%
Fentanyl	135,512	2,446,394	0.53%	1,295,259,623	15.14%
Oxymorphone	13,976	1,836,620	0.39%	107,450,903	1.26%
Tapentadol	11,548	1,592,494	0.34%	49,248,600	0.58%
Meperidine	12,670	600,325	0.13%	10,184,286	0.12%
Opium, Powdered	2,083	78,780	0.02%	3,913,200	0.05%
Dihydrocodeine	735	49,896	0.01%	213,248	0.00%
Levorphanol	82	9,800	0.00%	126,225	0.00%
Methadone	44,820	14,864,700	3.20%	1,149,912,674	13.44%
Buprenorphine	90,770	7,546,875	1.62%	1,663,193,794	19.45%
Total	1,462,630	465,121,322	100.00%	8,553,177,070	100.00%

122. Table 17 shows that virtually all transactions involving Dispensers in Cuyahoga County were reported by Distributors.

Table 17 Transactions in Cuyahoga County, by Seller's Business Activity

Seller Business Activity	# of Transactions	Dosage Units	Dosage Units %	MME	MME %
Distributor	1,460,925	463,973,914	99.75%	8,530,207,187	99.73%
Manufacturer	1,705	1,147,408	0.25%	22,969,883	0.27%
Total	1,462,630	465,121,322	100.00%	8,553,177,070	100.00%

123. In Cuyahoga County, 89% of opioid Dosage Units and 78% of opioid MME ended up at chain and retail pharmacies. Almost all of the remaining Dosage Units and MME (11% and 14%, respectively) went to hospitals. See Table 18.

Table 18 Transactions in Cuyahoga County, by Buyer's Business Activity

Buyer Business Activity	# of Transactions	Dosage Units	Dosage Units %	MME	MME %
Chain Pharmacy	1,059,110	326,837,697	70.27%	5,006,422,471	58.53%
Retail Pharmacy	208,475	86,467,309	18.59%	1,648,049,520	19.27%
Hospital/Clinic	163,488	42,561,130	9.15%	1,018,080,253	11.90%
Hospital/Clinic-VA	16,847	8,217,562	1.77%	147,835,880	1.73%
Practitioner	11,375	859,850	0.18%	14,471,530	0.17%
Practitioner-DW/100	602	89,822	0.02%	18,260,081	0.21%
Practitioner-DW/275	548	70,024	0.02%	14,516,307	0.17%
Maint & Detox	1,119	13,080	0.00%	652,657,912	7.63%
M/O Pharmacy	877	0	0.00%	32,137,168	0.38%
Other ¹	189	4,848	0.00%	745,949	0.01%
Total	1,462,630	465,121,322	100.00%	8,553,177,070	100.00%

¹ Each of the following Buyer Business Activities account for 0.01% or less of Dosage Units and MME: Detoxification, MLP-Ambulance Service, MLP-Animal Shelter, MLP-Nurse Practitioner, MLP-Optometrist, MLP-Physician Assistant, Practitioner-DW/30, and Teaching Institution.

124. Table 19 shows that Cuyahoga County received significantly more opioid Dosage Units and MME over time from 2006 to 2014. Dosage Units and MME increased every year between 2006 and 2011, with total increases of 47% and 50%, respectively.

Table 19 Transactions in Cuyahoga County, by Year

Transaction Year	# of Transactions	Dosage Units	Dosage Units %	MME	MME %
2006	141,730	40,072,937	8.62%	712,191,543	8.33%
2007	150,168	44,899,420	9.65%	811,147,405	9.48%
2008	153,720	48,551,832	10.44%	862,751,958	10.09%
2009	163,862	53,340,315	11.47%	958,985,664	11.21%
2010	169,841	56,299,047	12.10%	1,044,624,918	12.21%
2011	175,750	59,091,969	12.70%	1,070,529,292	12.52%
2012	170,308	56,572,772	12.16%	1,035,876,520	12.11%
2013	175,241	54,360,369	11.69%	1,029,702,861	12.04%
2014	162,010	51,932,661	11.17%	1,027,366,908	12.01%
Total	1,462,630	465,121,322	100.00%	8,553,177,070	100.00%

B. Summit County

125. According to the ARCOS Data, between 2006 and 2014, Dispensers in Summit County received 5.16 billion MME of opioids. Given the county's population of 542,000⁵³, Dispensers received enough opioids for every resident in the county to consume 1,057 MME every year from 2006 to 2014. Table 20 through Table 23 summarize the Sales to Dispenser transactions reported in the ARCOS Data for Summit County.

126. In Summit County, hydrocodone and oxycodone accounted for more than 84% of Dosage Units. Summit County reported relatively more morphine and less buprenorphine than Cuyahoga County.

⁵³ <https://factfinder.census.gov/>

Table 20 Transactions in Summit County, by Drug

Drug Name	# of Transactions	Dosage Units	Dosage Units %	MME	MME %
Oxycodone	243,079	119,066,784	43.17%	1,705,545,122	33.06%
Hydrocodone	275,316	112,919,415	40.94%	433,171,782	8.40%
Morphine	81,144	14,786,467	5.36%	476,880,548	9.25%
Codeine	24,191	6,924,360	2.51%	27,072,271	0.52%
Hydromorphone	30,070	6,212,534	2.25%	133,941,336	2.60%
Oxymorphone	16,598	2,511,800	0.91%	140,308,774	2.72%
Fentanyl	76,201	1,593,455	0.58%	832,218,731	16.13%
Tapentadol	5,006	617,765	0.22%	19,066,780	0.37%
Meperidine	6,400	412,450	0.15%	4,579,508	0.09%
Opium, Powdered	755	20,916	0.01%	1,017,720	0.02%
Dihydrocodeine	281	18,364	0.01%	72,107	0.00%
Levorphanol	16	2,200	0.00%	28,179	0.00%
Methadone	20,531	7,356,800	2.67%	636,426,866	12.34%
Buprenorphine	43,461	3,364,610	1.22%	747,852,636	14.50%
Total	823,049	275,807,920	100.00%	5,158,182,360	100.00%

127. Table 21 shows that nearly all transactions involving Dispensers in Summit County were reported by Distributors.

Table 21 Transactions in Summit County, by Seller's Business Activity

Seller Business Activity	# of Transactions	Dosage Units	Dosage Units %	MME	MME %
Distributor	822,754	275,721,122	99.97%	5,157,389,137	99.98%
Manufacturer	295	86,798	0.03%	793,223	0.02%
Total	823,049	275,807,920	100.00%	5,158,182,360	100.00%

128. In Summit County, 96% of opioid Dosage Units and 89% of MME ended up at chain and retail pharmacies. The next largest consumers were hospitals, with 3-4% of Dosage Units and MME. See Table 22.

Table 22 Transactions in Summit County, by Buyer's Business Activity

Buyer Business Activity	# of Transactions	Dosage Units	Dosage Units %	MME	MME %
Chain Pharmacy	506,906	175,916,873	63.78%	2,479,832,111	48.08%
Retail Pharmacy	257,374	87,840,560	31.85%	2,088,599,922	40.49%
Hospital/Clinic	47,674	9,564,699	3.47%	181,052,043	3.51%
Hospital/Clinic-VA	1,659	1,155,600	0.42%	16,478,791	0.32%
M/O Pharmacy	4,315	1,025,214	0.37%	14,650,694	0.28%
Practitioner	3882	159,034	0.06%	5,432,003	0.11%
Maint & Detox	749	67,560	0.02%	368,501,544	7.14%
Practitioner-DW/100	280	55,058	0.02%	1,986,356	0.04%
Practitioner-DW/275	137	7,930	0.00%	1,436,732	0.03%
Other ¹	73	15,392	0.01%	212,166	0.00%
Total	823,049	275,807,920	100.00%	5,158,182,360	100.00%

¹ Each of the following Buyer Business Activities account for 0.01% or less of Dosage Units and MME: MLP-Ambulance Service, MLP-Animal Shelter, MLP-Nurse Practitioner, and Practitioner-DW/30.

129. Table 23 shows that Summit County received significantly more opioid Dosage Units and MME over time. Between 2006 and 2011, the Dosage Units and MME increased 48% and 38%, respectively.

Table 23 Transactions in Summit County, by Year

Transaction Year	# of Transactions	Dosage Units	Dosage Units %	MME	MME %
2006	77,411	23,550,497	8.54%	461,362,220	8.94%
2007	84,234	26,970,358	9.78%	509,170,704	9.87%
2008	84,451	28,237,289	10.24%	501,002,624	9.71%
2009	87,859	31,213,553	11.32%	557,701,967	10.81%
2010	91,694	33,422,003	12.12%	637,903,494	12.37%
2011	95,704	34,823,020	12.63%	638,466,593	12.38%
2012	99,294	34,200,611	12.40%	629,658,250	12.21%
2013	105,732	32,902,433	11.93%	626,865,431	12.15%
2014	96,670	30,488,156	11.05%	596,051,076	11.56%
Total	823,049	275,807,920	100.00%	5,158,182,360	100.00%

IX. Transaction Analysis

130. I implemented various approaches to identify transactions meeting specified criteria using the non-public ARCOS Data from 2006 to 2014, supplemented with Defendant transaction data where the ARCOS Data is obviously missing transactions that are included in the transactions produced by Defendants in discovery and to the extent I have Defendant transaction data for the periods before 2006 and after 2014. I calculated the results separately for each of twelve controlled substance drug codes.⁵⁴

A. Maximum Monthly, Trailing Six-month Threshold

131. Under the first approach, I identify transactions that cause the number of dosage units shipped by a Distributor to a Pharmacy in a calendar month to exceed the highest number of dosage units shipped by the Distributor to the Pharmacy in any one of the six preceding calendar months. For example, if the number of dosage units containing hydrocodone shipped from a Distributor to a Pharmacy in February, March, April, May, June, and July were 5,000; 10,000; 7,000; 8,000; 9,000; and 9,500 respectively, a requested transaction in August would be flagged if it would cause the number of dosage units containing hydrocodone the Distributor shipped to the Pharmacy to exceed 10,000. Any reported transactions containing hydrocodone on that date and all reported transactions containing hydrocodone from that Distributor to that Pharmacy thereafter are flagged.

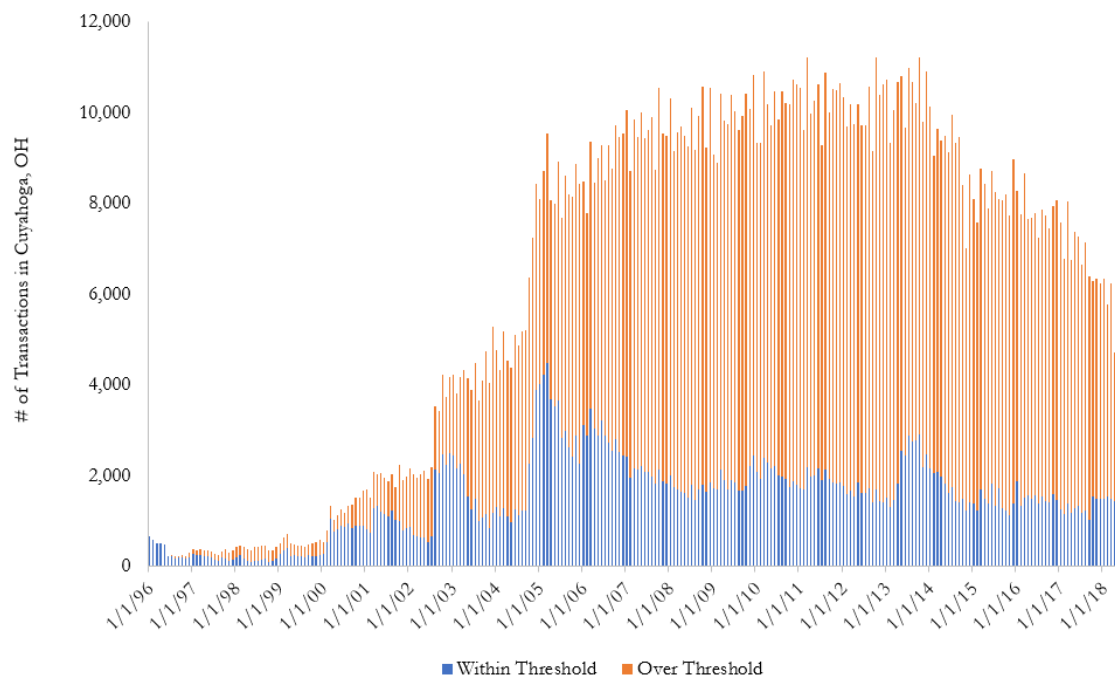
132. In this approach and the others implemented below I have been asked by Counsel to assume that the Distributor did not effectively investigate

⁵⁴ I do not analyze transactions in two treatment drugs: buprenorphine and methadone.

the flagged transactions and so every subsequent transaction of that drug code is also flagged because the Distributor had an unfulfilled obligation to detect and investigate the first flagged transaction.

133. Figure 11 illustrates total opioid transactions from Distributors to retail and chain pharmacies into Cuyahoga County from 1996 to 2018. The Trailing Six-Month Maximum Threshold methodology flags 76.0% of transactions accounting for 89.6% of dosage units, 73.5% of MME and 83.2% of drug weight shipped into Cuyahoga County. Additional charts and tables reflecting the result of applying this methodology and the methodologies below to each Distributor are in Appendix 10.

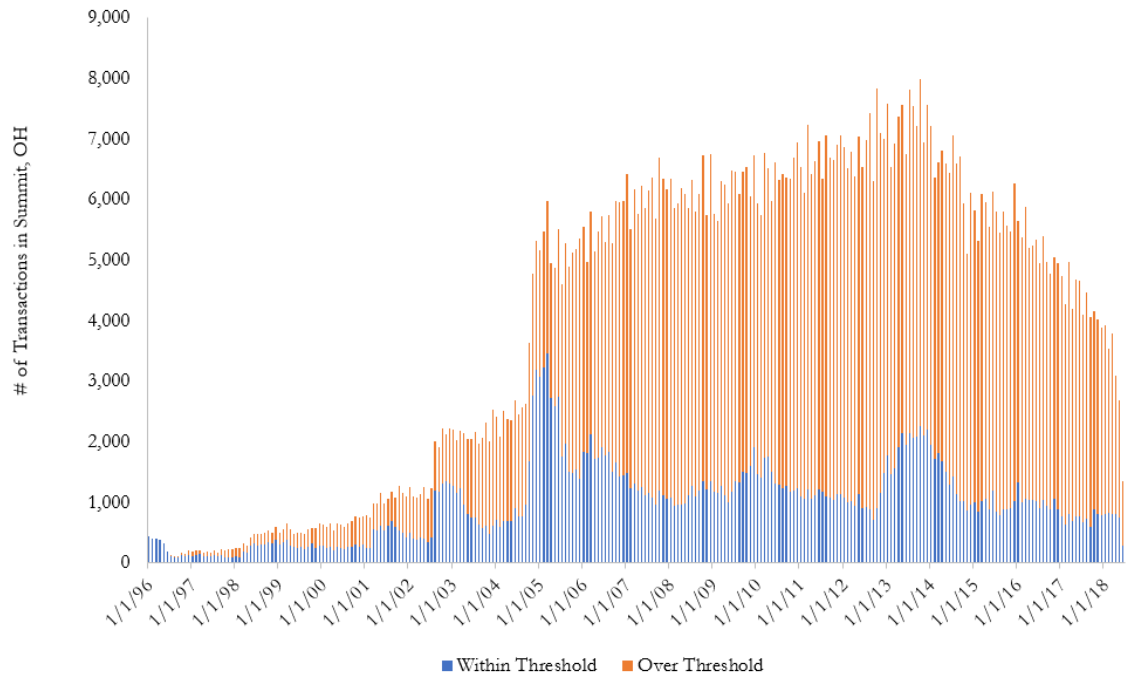
Figure 11 Trailing Six-Month Maximum Threshold Flagged Transactions, Cuyahoga County, OH 1996-2018



134. Figure 12 illustrates total transactions from Distributors to retail and chain pharmacies into Summit County from 1996 to 2018. The Trailing Six-Month Maximum Threshold methodology flags 75.4% of transactions

accounting for 88.5% of dosage units, 71.4% of MME and 83.1% of drug weight shipped into Summit County.

Figure 12 Trailing Six-Month Maximum Threshold Flagged Transactions, Summit County, OH, 1996-2018



135. Table 24 and Table 25 summarize the transactions in transactions flagged based on the Trailing Six-Month Maximum Threshold Approach in Cuyahoga and Summit Counties.

Table 24 Trailing Six-Month Maximum Threshold Flagged Transactions,
Cuyahoga County, OH 1996-2018

# of Flagged Transactions	Oxycodone	Hydrocodone	Morphine	Hydromorphone	Oxymorphone	Other	Total
AmerisourceBergen	99,137	49,339	14,957	2,874	545	11,597	178,449
Anda, Inc	700	1,723	0	2	0	69	2,494
Cardinal Health	192,799	94,450	26,389	3,061	3,974	30,020	350,693
CVS	n/a	109,055	n/a	n/a	n/a	8,772	117,827
Discount Drug Mart	n/a	32,583	0	n/a	n/a	3,229	35,812
H. D. Smith	269	0	0	0	0	0	269
HBC Service Co	4,909	41,114	0	0	0	1,275	47,298
Henry Schein Inc	n/a	n/a	n/a	n/a	n/a	n/a	n/a
McKesson Corp	129,021	89,263	9,185	759	538	6,265	235,031
Miami-Luken	0	0	0	0	n/a	0	0
Prescription Supply	5,008	489	1,220	134	0	40	6,891
Rite Aid	n/a	18,828	n/a	n/a	n/a	2,748	21,576
Walgreens	97,401	100,421	19,462	3,900	0	10,744	231,928
Wal-Mart	16,070	25,737	477	76	0	990	43,350
Total	545,314	563,002	71,690	10,806	5,057	75,749	1,271,618

Table 25 Trailing Six-Month Maximum Threshold Flagged Transactions, Summit County, OH 1996-2018

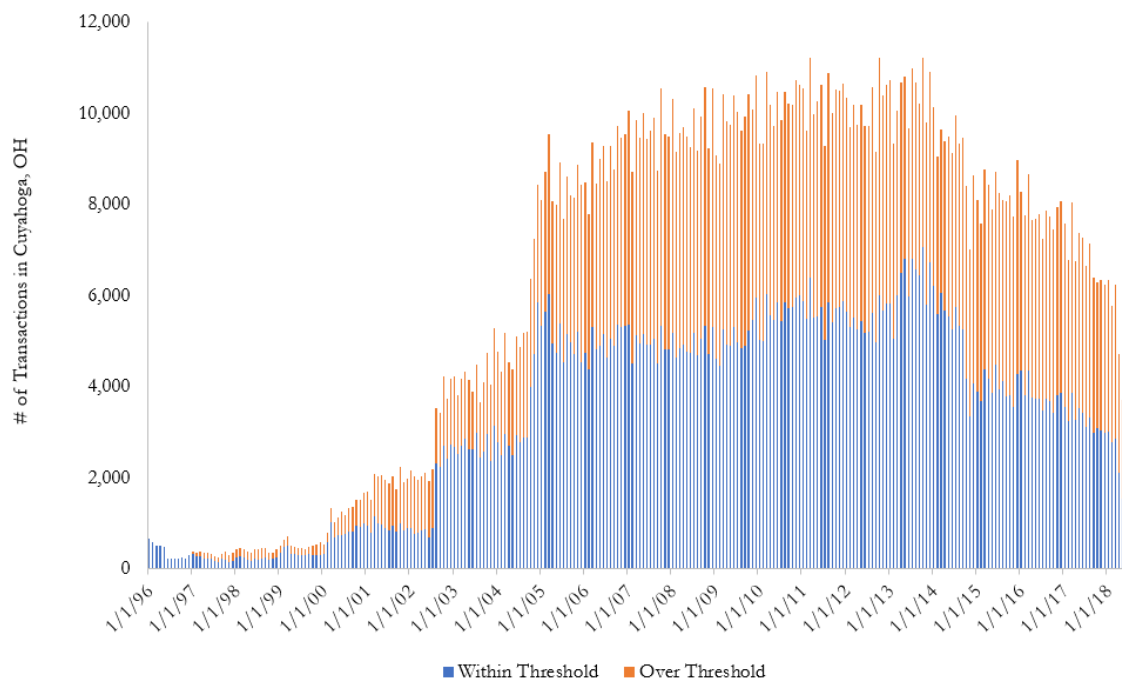
# of Flagged Transactions	Oxycodone	Hydrocodone	Morphine	Hydromorphone	Oxymorphone	Other	Total
AmerisourceBergen	77,175	52,681	21,289	6,341	2,830	10,804	171,120
Anda, Inc	690	1,302	121	2	0	188	2,303
Cardinal Health	111,200	50,300	24,731	5,707	2,638	13,065	207,641
CVS	n/a	45,927	n/a	n/a	n/a	2,624	48,551
Discount Drug Mart	n/a	8,500	0	n/a	n/a	720	9,220
H. D. Smith	60	125	0	n/a	0	0	185
HBC Service Co	2,682	26,651	0	0	0	703	30,036
Henry Schein Inc	n/a	n/a	n/a	n/a	n/a	n/a	n/a
McKesson Corp	96,172	64,409	20,338	5,156	4,116	6,280	196,471
Miami-Luken	2,999	1,308	391	0	236	0	4,934
Prescription Supply	16	4	0	0	0	0	20
Rite Aid	n/a	10,953	n/a	n/a	n/a	898	11,851
Walgreens	39,284	47,489	11,596	3,050	0	2,669	104,088
Wal-Mart	9,010	15,052	777	173	0	393	25,405
Total	339,288	324,701	79,243	20,429	9,820	38,344	811,825

B. Twice Trailing Twelve-Month Average Pharmacy Dosage Units

136. I identify transactions that cause the number of dosage units shipped by a Distributor to a Pharmacy in a calendar month to exceed twice the trailing twelve-month average dosage units to retail and chain pharmacies served by the Distributor. I have been asked by Counsel to assume that the Distributor did not effectively investigate the flagged transactions and so every subsequent transaction of that drug code is also flagged because the Distributor had an unfulfilled obligation to detect and investigate the first flagged transaction.

137. Figure 13 illustrates total opioid shipments into Cuyahoga County from 1996 to 2018 from ARCOS Data for 2006 to 2014 and, to the extent I have Defendant transaction data for the periods before 2006 and after 2014. The Twice Trailing Twelve-Month Average Pharmacy Dosage Units Threshold methodology flags 45.6% of transactions accounting for 54.9% of dosage units, 57.1% of MME and 59.0% of drug weight shipped into Cuyahoga County.

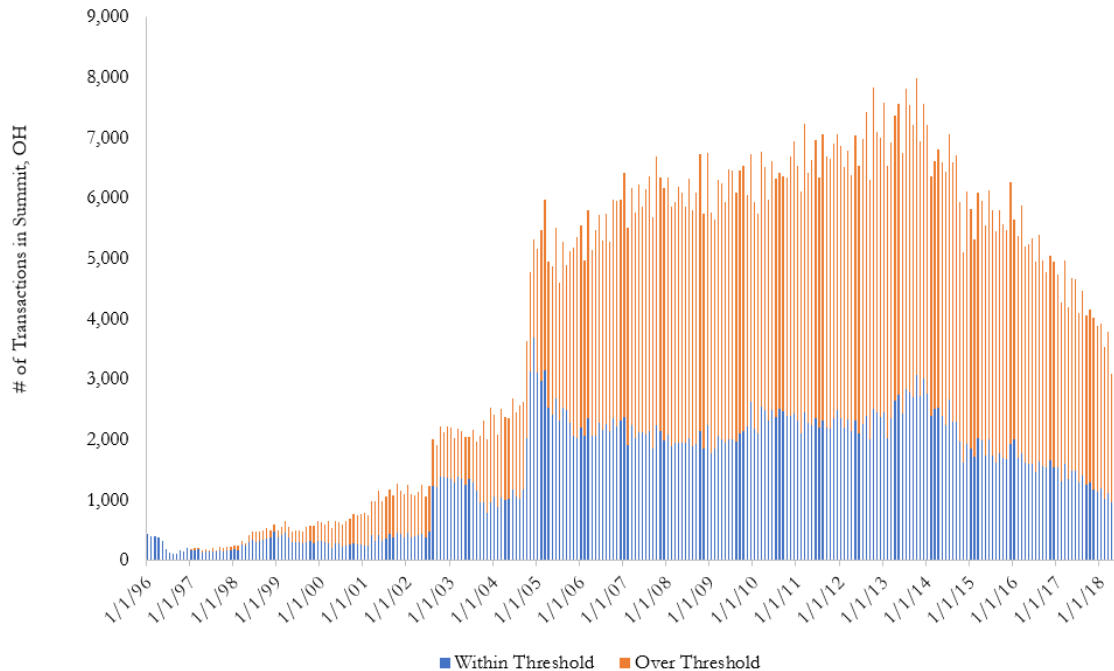
Figure 13 Twice Trailing Twelve-Month Average Pharmacy Dosage Units, Flagged Transactions, Cuyahoga County, OH 1996-2018



138. Figure 14 illustrates total shipments into Summit County from 1996 to 2018 from ARCOS Data for 2006 to 2014 and, to the extent I have Defendant transaction data for the periods before 2006 and after 2014. The Twice Trailing Twelve-Month Average Pharmacy Dosage Units Threshold

methodology flags 62.9% of transactions accounting for 72.5% of dosage units, 74.4% of MME and 72.3% of drug weight shipped to Summit County.

Figure 14 Twice Trailing Twelve-Month Average Pharmacy Dosage Units, Flagged Transactions, Summit County, OH 1996-2018



139. Table 26 and Table 27 summarize the transactions in transactions flagged based on the Twice Trailing Twelve-Month Average Pharmacy Dosage Units Threshold in Cuyahoga and Summit Counties.

Table 26 Twice Trailing Twelve-Month Average Pharmacy Dosage Units
Threshold Flagged Transactions, Cuyahoga County, 1996-2018

# of Flagged Transactions	Oxycodone	Hydrocodone	Morphine	Hydromorphone	Oxymorphone	Other	Total
AmerisourceBergen	45,288	26,985	8,256	2,502	844	16,731	100,606
Anda, Inc	587	950	51	6	0	256	1,850
Cardinal Health	121,206	82,155	24,003	4,621	5,713	56,834	294,532
CVS	n/a	34,001	n/a	n/a	n/a	6,422	40,423
Discount Drug Mart	n/a	32,848	0	n/a	n/a	2,554	35,402
H. D. Smith	311	0	12	4	11	17	355
HBC Service Co	4,942	4,690	29	104	0	669	10,434
Henry Schein Inc	n/a	n/a	n/a	n/a	n/a	n/a	n/a
McKesson Corp	51,631	68,503	8,532	1,505	1,344	22,790	154,305
Miami-Luken	0	0	0	0	n/a	0	0
Prescription Supply	802	471	1,176	174	20	690	3,333
Rite Aid	n/a	4,145	n/a	n/a	n/a	1,452	5,597
Walgreens	42,801	18,937	15,801	5,665	30	22,409	105,643
Wal-Mart	8,469	806	494	117	0	1,357	11,243
Total	276,037	274,491	58,354	14,698	7,962	132,181	763,723

Table 27 Twice Trailing Twelve-Month Average Pharmacy Dosage Units Threshold Flagged Transactions, Summit County, OH 1996-2018

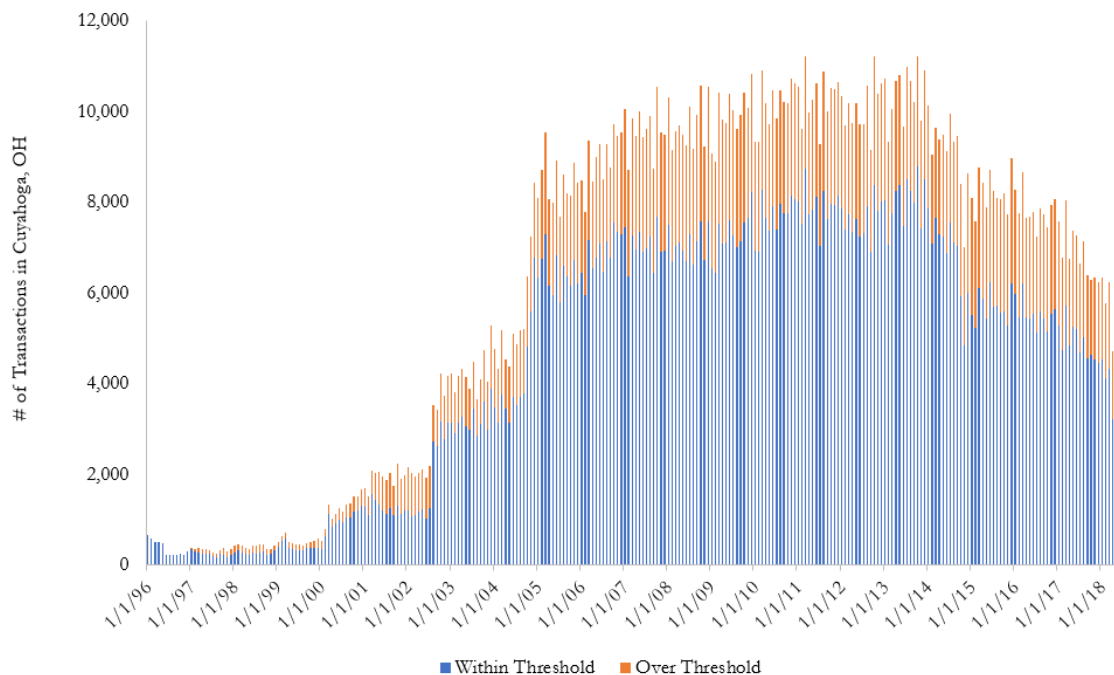
# of Flagged Transactions	Oxycodone	Hydrocodone	Morphine	Hydromorphone	Oxymorphone	Other	Total
AmerisourceBergen	41,408	48,241	17,443	6,140	3,737	22,741	139,710
Anda, Inc	1,081	1,245	221	22	0	325	2,894
Cardinal Health	84,118	48,828	27,703	7,966	4,458	35,525	208,598
CVS	n/a	27,081	n/a	n/a	n/a	1,443	28,524
Discount Drug Mart	n/a	7,405	0	n/a	n/a	533	7,938
H. D. Smith	0	105	0	n/a	0	23	128
HBC Service Co	2,025	16,692	200	28	22	491	19,458
Henry Schein Inc	n/a	n/a	n/a	n/a	n/a	n/a	n/a
McKesson Corp	64,582	62,291	20,257	6,303	5,538	24,320	183,291
Miami-Luken	2,939	1,222	452	88	304	388	5,393
Prescription Supply	0	4	0	1	0	0	5
Rite Aid	n/a	8,235	n/a	n/a	n/a	376	8,611
Walgreens	15,942	28,076	10,431	3,488	44	9,018	66,999
Wal-Mart	2,657	695	729	199	27	622	4,929
Total	214,752	250,120	77,436	24,235	14,130	95,805	676,478

C. Three Times Trailing Twelve-Month Average Pharmacy Dosage Units

140. I identify transactions that cause the number of dosage units shipped by a Distributor to a Pharmacy in a calendar month to exceed three times the trailing twelve-month average dosage units to retail and chain pharmacies served by the Distributor. I have been asked by Counsel to assume that the Distributor did not effectively investigate the flagged transactions and so every subsequent transaction of that drug code is also flagged because the Distributor had an unfulfilled obligation to detect and investigate the first flagged transaction.

141. Figure 15 illustrates total opioid shipments into Cuyahoga County from 1996 to 2018 from ARCOS Data for 2006 to 2014 and, to the extent I have Defendant transaction data for the periods before 2006 and after 2014. The Three Times Trailing Twelve-Month Average Pharmacy Dosage Units Threshold methodology flags 26.0% of transactions accounting for 32.3% of dosage units, 33.5% of MME and 34.8% of drug weight shipped into Cuyahoga County.

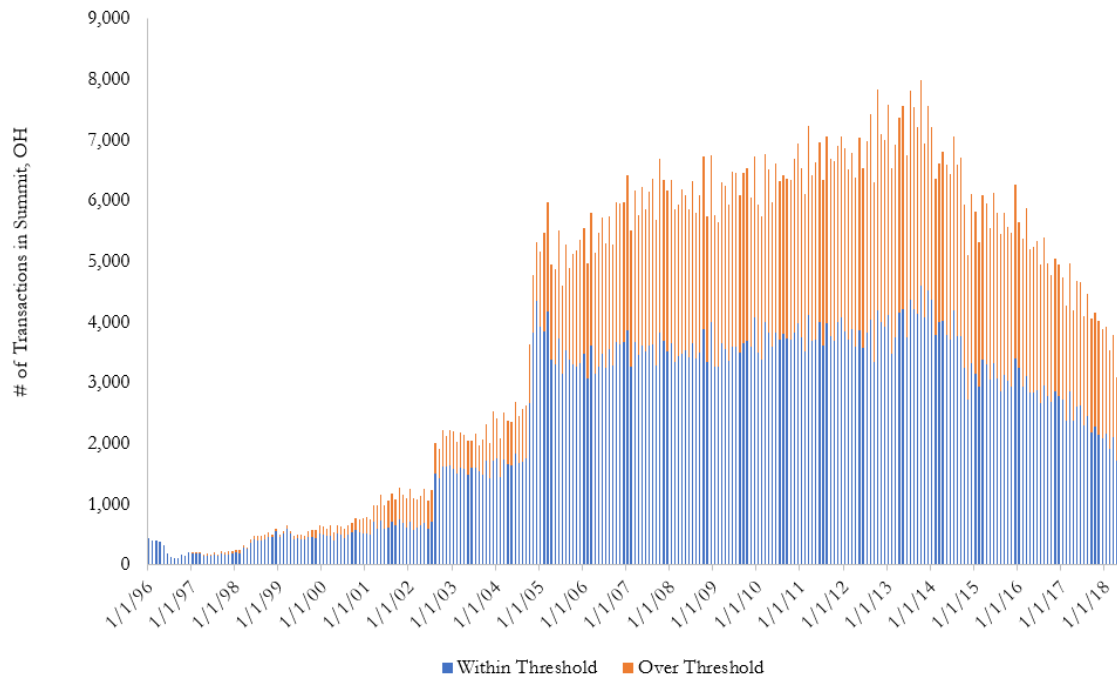
Figure 15 Three Times Trailing Twelve-Month Average Pharmacy Dosage Units Flagged Transactions, Cuyahoga County, OH 1996-2018



142. Figure 16 illustrates total shipments into Summit County from 1996 to 2018 from ARCOS Data for 2006 to 2014 and, to the extent I have Defendant transaction data for the periods before 2006 and after 2014. The Three Times Trailing Twelve-Month Average Pharmacy Dosage Units Threshold methodology flags 40.5% of transactions accounting for 50.0% of

dosage units, 53.3% of MME and 51.4% of drug weight shipped into Summit County.

Figure 16 Three Times Trailing Twelve-Month Average Pharmacy Dosage Units Flagged Transactions, Summit County, OH 1996-2018



143. Table 28 and Table 29 summarize the transactions in transactions flagged based on the Three Times Trailing Twelve-Month Average Pharmacy Dosage Units Threshold in Cuyahoga and Summit Counties.

Table 28 Three Times Trailing Twelve-Month Average Pharmacy Dosage Units Threshold Flagged Transactions, Cuyahoga County, OH 1996-2018

# of Flagged Transactions	Oxycodone	Hydrocodone	Morphine	Hydromorphone	Oxymorphone	Other	Total
AmerisourceBergen	22,663	14,792	3,933	1,319	289	10,561	53,557
Anda, Inc	306	584	3	0	0	182	1,075
Cardinal Health	62,297	67,273	17,572	2,867	4,475	39,223	193,707
CVS	n/a	13,485	n/a	n/a	n/a	2,619	16,104
Discount Drug Mart	n/a	32,445	0	n/a	n/a	1,995	34,440
H. D. Smith	311	0	0	0	0	0	311
HBC Service Co	1,652	2,069	12	34	0	42	3,809
Henry Schein Inc	n/a	n/a	n/a	n/a	n/a	n/a	n/a
McKesson Corp	31,620	41,655	4,172	730	581	13,998	92,756
Miami-Luken	0	0	0	0	n/a	0	0
Prescription Supply	96	468	838	148	1	428	1,979
Rite Aid	n/a	2,631	n/a	n/a	n/a	719	3,350
Walgreens	909	4,490	9,292	3,753	9	11,522	29,975
Wal-Mart	3,239	0	177	69	0	150	3,635
Total	123,093	179,892	35,999	8,920	5,355	81,439	434,698

Table 29 Three Times Trailing Twelve-Month Average Pharmacy Dosage Units Threshold Flagged Transactions, Summit County, OH 1996-2018

# of Flagged Transactions	Oxycodone	Hydrocodone	Morphine	Hydromorphone	Oxymorphone	Other	Total
AmerisourceBergen	26,024	40,096	10,643	4,823	3,051	13,724	98,361
Anda, Inc	981	993	177	21	0	295	2,467
Cardinal Health	49,733	42,267	21,073	6,408	2,295	24,609	146,385
CVS	n/a	17,930	n/a	n/a	n/a	370	18,300
Discount Drug Mart	n/a	7,278	0	n/a	n/a	403	7,681
H. D. Smith	0	91	0	n/a	0	23	114
HBC Service Co	857	8,099	103	0	13	114	9,186
Henry Schein Inc	n/a	n/a	n/a	n/a	n/a	n/a	n/a
McKesson Corp	36,410	48,607	16,642	4,721	4,198	16,232	126,810
Miami-Luken	0	1,111	0	79	243	331	1,764
Prescription Supply	0	4	0	0	0	0	4
Rite Aid	n/a	2,062	n/a	n/a	n/a	129	2,191
Walgreens	0	6,712	6,788	2,491	44	4,516	20,551
Wal-Mart	1,403	0	713	173	0	131	2,420
Total	115,408	175,250	56,139	18,716	9,844	60,877	436,234

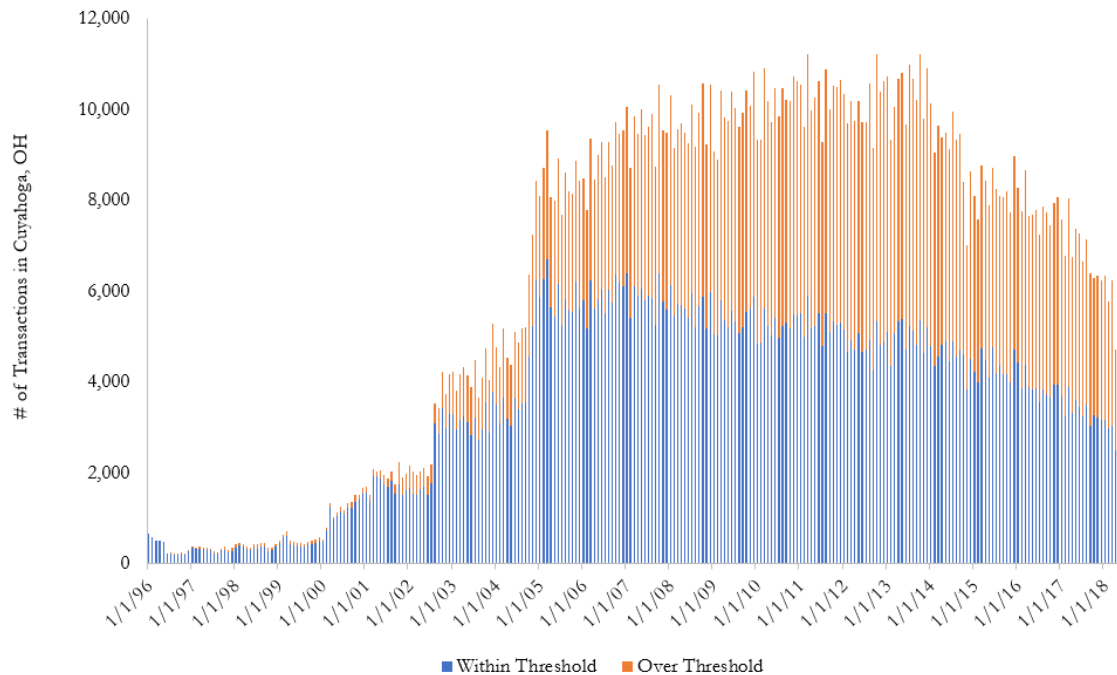
D. Maximum 8,000 Dosage Units Monthly

144. I identify transactions that cause the number of dosage units shipped by a Distributor to a Pharmacy in a calendar month to exceed 8,000 dosage units. I have been asked by Counsel to assume that the Distributor did not effectively investigate the flagged transactions and so every subsequent transaction of that drug code is also flagged because the Distributor had an unfulfilled obligation to detect and investigate the first flagged transaction.

145. Figure 17 illustrates total opioid shipments into Cuyahoga County from 1996 to 2018 from ARCOS Data for 2006 to 2014 and, to the extent I have Defendant transaction data for the periods before 2006 and after

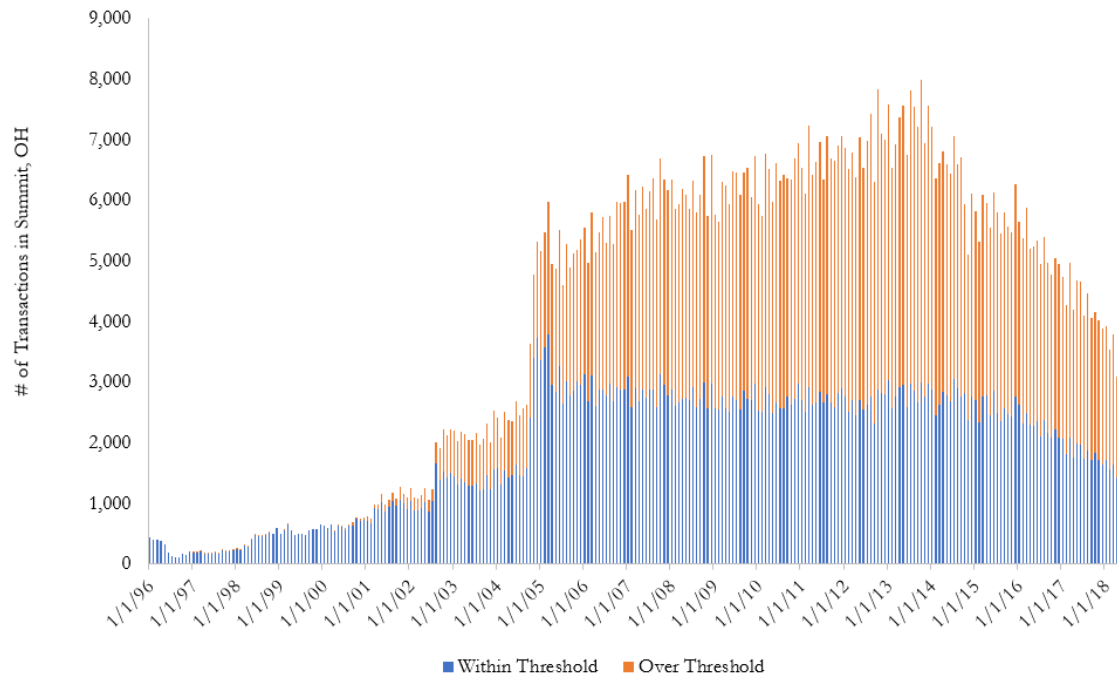
2014. The Maximum 8,000 Dosage Units Monthly Threshold methodology flags 42.6% of transactions accounting for 61.4% of dosage units, 50.2% of MME and 49.9% of drug weight shipped into Cuyahoga County.

Figure 17 Maximum 8,000 Dosage Units Monthly Flagged Transactions, Cuyahoga County, OH 1996-2018



146. Figure 18 illustrates total shipments into Summit County from 1996 to 2018 from ARCOS Data for 2006 to 2014 and, to the extent I have Defendant transaction data for the periods before 2006 and after 2014. The Maximum 8,000 Dosage Units Monthly Threshold methodology flags 52.4% of transactions accounting for 76.0% of dosage units, 54.7% of MME and 62.7% of drug weight shipped into Summit County.

Figure 18 Maximum 8,000 Dosage Units Monthly Flagged Transactions, Summit County, OH 1996-2018



147. Table 30 and Table 31 summarize the transactions in transactions flagged based on the Maximum 8,000 Dosage Units Monthly Threshold Approach in Cuyahoga and Summit Counties.

Table 30 Maximum 8,000 Dosage Units Monthly Threshold Flagged Transactions, Cuyahoga County, OH 1996-2018

# of Flagged Transactions	Oxycodone	Hydrocodone	Morphine	Hydromorphone	Oxymorphone	Other	Total
AmerisourceBergen	94,012	27,456	949	0	0	1,187	123,604
Anda, Inc	17	55	0	0	0	0	72
Cardinal Health	110,826	48,016	2,102	0	0	1,731	162,675
CVS	n/a	63,845	n/a	n/a	n/a	0	63,845
Discount Drug Mart	n/a	20,875	0	n/a	n/a	0	20,875
H. D. Smith	308	0	0	0	0	0	308
HBC Service Co	3,992	28,758	0	0	0	0	32,750
Henry Schein Inc	n/a	n/a	n/a	n/a	n/a	n/a	n/a
McKesson Corp	77,402	31,364	0	0	0	0	108,766
Miami-Luken	0	0	0	0	n/a	0	0
Prescription Supply	3,312	0	0	0	0	0	3,312
Rite Aid	n/a	9,603	n/a	n/a	n/a	0	9,603
Walgreens	88,496	74,958	0	0	0	0	163,454
Wal-Mart	9,165	15,540	0	0	0	0	24,705
Total	387,530	320,470	3,051	0	0	2,918	713,969

Table 31 Maximum 8,000 Dosage Units Monthly Threshold Flagged Transactions, Summit County, OH 1996-2018

# of Flagged Transactions	Oxycodone	Hydrocodone	Morphine	Hydromorphone	Oxymorphone	Other	Total
AmerisourceBergen	68,640	50,724	3,831	1,071	2,265	0	126,531
Anda, Inc	811	25	109	0	0	0	945
Cardinal Health	80,037	31,077	3,214	927	748	570	116,573
CVS	n/a	46,272	n/a	n/a	n/a	0	46,272
Discount Drug Mart	n/a	6,299	0	n/a	n/a	0	6,299
H. D. Smith	0	0	0	n/a	0	0	0
HBC Service Co	2,107	25,874	0	0	0	0	27,981
Henry Schein Inc	n/a	n/a	n/a	n/a	n/a	n/a	n/a
McKesson Corp	78,847	44,278	4,036	1,050	0	0	128,211
Miami-Luken	3,180	0	0	0	0	0	3,180
Prescription Supply	0	0	0	0	0	0	0
Rite Aid	n/a	12,057	n/a	n/a	n/a	0	12,057
Walgreens	36,774	48,454	0	0	0	0	85,228
Wal-Mart	2,897	7,740	0	0	0	0	10,637
Total	273,293	272,800	11,190	3,048	3,013	570	563,914

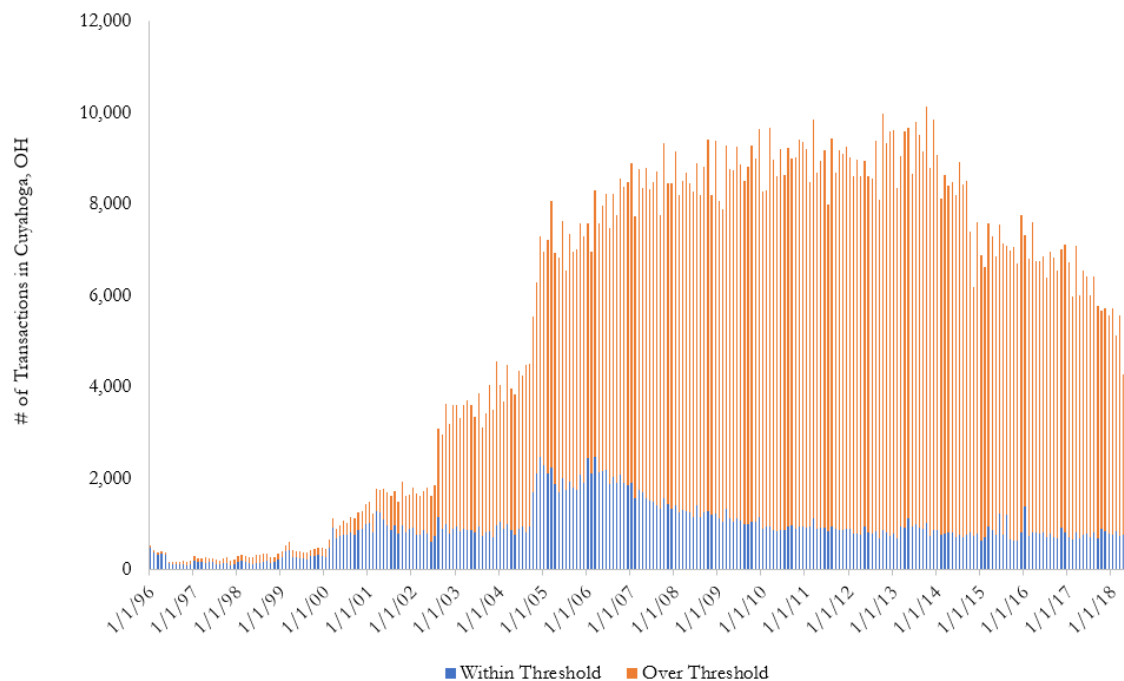
E. Maximum Daily Dosage Units

148. I identify transactions that cause the number of dosage units shipped by a Distributor to a Pharmacy in a day to exceed a number of dosage units that varies by drug type and within some drug types by formulation.⁵⁵ I have been asked by Counsel to assume that the Distributor did not effectively investigate the flagged transactions and so every subsequent transaction of that drug code is also flagged because the Distributor had an unfulfilled obligation to detect and investigate the first flagged transaction.

⁵⁵ Maximum Daily Dosage Units used as specified in CAH_MDLPRIORPRO_DEA07_01384160

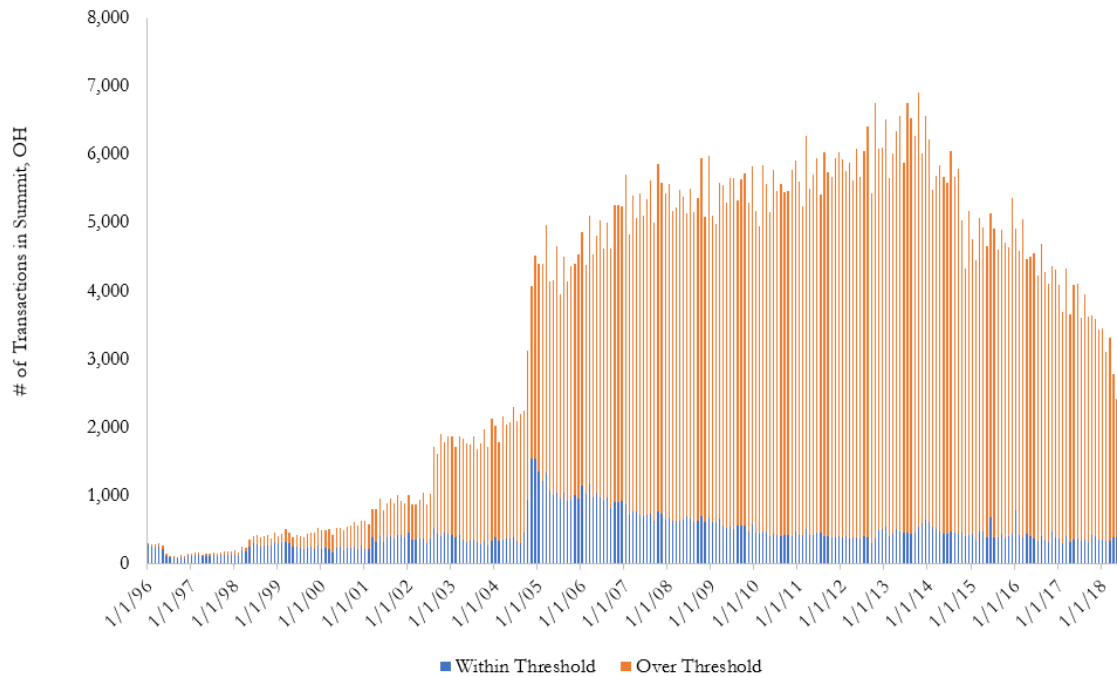
149. Figure 19 illustrates total opioid shipments into Cuyahoga County from 1996 to 2018 from ARCOS Data for 2006 to 2014 and, to the extent I have Defendant transaction data for the periods before 2006 and after 2014. The Maximum Daily Dosage Units Threshold methodology flags 83.3% of transactions accounting for 92.0% of dosage units, 91.1% of MME and 84.8% of drug weight shipped into Cuyahoga County.

Figure 19 Maximum Daily Dosage Units, Any Order Subsequent to an Flagged Order, Cuyahoga County



150. Figure 20 illustrates total opioid transactions into Summit County. The Maximum Daily Dosage Units Threshold methodology flags 86.8% of transactions accounting for 94.4% of dosage units, 94.0% of MME and 89.6% of drug weight shipped into Summit County.

Figure 20 Maximum Daily Dosage Units, Any Order Subsequent to an Flagged Transactions, Summit County



151. Table 32 and Table 33 summarize the transactions in transactions flagged based on the Maximum Daily Dosage Units Threshold Approach in Cuyahoga and Summit Counties.

Table 32 Maximum Daily Dosage Units Threshold Flagged Transactions in Cuyahoga County, 1996-2018

# of Flagged Transactions	Oxycodone	Hydrocodone	Morphine	Hydromorphone	Oxymorphone	Other	Total
AmerisourceBergen	107,350	52,226	18,018	3,366	n/a	3,292	184,252
Anda, Inc	904	2,129	46	20	n/a	95	3,194
Cardinal Health	166,869	88,662	30,253	4,244	n/a	10,147	300,175
CVS	n/a	115,449	n/a	n/a	n/a	5,951	121,400
Discount Drug Mart	n/a	32,424	0	n/a	n/a	2,036	34,460
H. D. Smith	311	19	0	4	n/a	18	352
HBC Service Co	5,978	46,103	0	0	n/a	10	52,091
Henry Schein Inc	n/a	n/a	n/a	n/a	n/a	n/a	n/a
McKesson Corp	118,299	88,832	9,825	1,154	n/a	1,298	219,408
Miami-Luken	2	133	0	0	n/a	0	135
Prescription Supply	5,351	521	1,471	162	n/a	6	7,511
Rite Aid	n/a	21,291	n/a	n/a	n/a	1,343	22,634
Walgreens	97,777	107,036	21,923	3,733	n/a	6,949	237,418
Wal-Mart	14,593	26,963	818	76	n/a	387	42,837
Total	517,434	581,788	82,354	12,759	n/a	31,532	1,225,867

Table 33 Maximum Daily Dosage Units Threshold Flagged Transactions in Summit County, 1996-2018

# of Flagged Transactions	Oxycodone	Hydrocodone	Morphine	Hydromorphone	Oxymorphone	Other	Total
AmerisourceBergen	80,140	59,406	23,672	7,252	n/a	2,196	172,666
Anda, Inc	1,130	1,566	205	41	n/a	19	2,961
Cardinal Health	104,253	52,285	27,023	6,358	n/a	4,104	194,023
CVS	n/a	49,701	n/a	n/a	n/a	1,759	51,460
Discount Drug Mart	n/a	8,435	0	n/a	n/a	357	8,792
H. D. Smith	0	74	0	n/a	n/a	0	74
HBC Service Co	2,858	29,533	33	0	n/a	0	32,424
Henry Schein Inc	n/a	n/a	n/a	n/a	n/a	n/a	n/a
McKesson Corp	96,342	69,871	21,349	5,883	n/a	518	193,963
Miami-Luken	3,184	1,404	476	53	n/a	0	5,117
Prescription Supply	15	5	0	1	n/a	0	21
Rite Aid	n/a	12,512	n/a	n/a	n/a	177	12,689
Walgreens	40,192	50,679	12,257	3,059	n/a	353	106,540
Wal-Mart	7,411	14,905	1,013	169	n/a	96	23,594
Total	335,525	350,376	86,028	22,816	n/a	9,579	804,324

F. Additional Identification

152. I have been asked by Counsel to assume that Chain Distributors may have had knowledge of - or information available to inform them of - opioid shipments from all Distributors to the Chain Distributor's affiliated pharmacies. I have re-run the five identification routines described above assuming that the Chain Distributors could have flagged transactions based on this expanded information set and report the results for the Chain Distributors in Table 34 through Table 43 below. Additional charts and tables reflecting the result of applying methodologies below to each Chain Distributor are in Appendix 11.

1. Maximum Monthly, Trailing Six-month Threshold

Table 34 Trailing Six-Month Maximum Threshold Flagged Transactions, Cuyahoga County, OH 2006-2014

No. of Flagged Transactions	Oxycodone	Hydrocodone	Morphine	Hydromorphone	Oxymorphone	Other	Total
CVS	65,249	86,461	9,769	908	1,130	12,154	175,671
Discount Drug Mart	18,313	24,531	2,416	98	0	1,786	47,144
HBC / Giant Eagle	27,810	74,444	297	20	0	5,202	107,773
Rite Aid	45,986	38,903	5,553	282	396	6,000	97,120
Walgreens	100,484	86,597	22,490	5,374	1,294	12,712	228,951
Wal-Mart	10,520	22,448	213	74	0	1,185	34,440
Total	268,362	333,384	40,738	6,756	2,820	39,039	691,099

Table 35 Trailing Six-Month Maximum Threshold Flagged Transactions, Summit County, OH 2006-2014

No. of Flagged Transactions	Oxycodone	Hydrocodone	Morphine	Hydromorphone	Oxymorphone	Other	Total
CVS	34,067	37,475	9,393	2,242	986	3,487	87,650
Discount Drug Mart	6,052	6,300	1,305	245	71	420	14,393
HBC / Giant Eagle	21,246	50,968	3,772	941	119	2,415	79,461
Rite Aid	18,263	18,990	4,587	1,106	651	1,665	45,262
Walgreens	39,482	39,538	13,088	4,099	280	3,772	100,259
Wal-Mart	5,960	13,442	522	158	0	494	20,576
Total	125,070	166,713	32,667	8,791	2,107	12,253	347,601

2. *Twice Trailing Twelve-Month Average Pharmacy Dosage Units*

Table 36 Twice Trailing Twelve-Month Average Pharmacy Dosage Units Threshold Flagged Transactions, 2006-2014

No. of Flagged Transactions	Oxycodone	Hydrocodone	Morphine	Hydromorphone	Oxymorphone	Other	Total
CVS	30,660	17,708	4,925	639	1,731	15,169	70,832
Discount Drug Mart	4,897	1,600	1,637	145	140	3,532	11,951
HBC / Giant Eagle	0	0	126	78	102	3,543	3,849
Rite Aid	31,051	8,623	3,661	680	1,162	6,999	52,176
Walgreens	65,885	5,542	8,621	4,170	2,943	18,839	106,000
Wal-Mart	4,883	0	154	57	72	1,101	6,267
Total	137,376	33,473	19,124	5,769	6,150	49,183	251,075

Table 37 Twice Trailing Twelve-Month Average Pharmacy Dosage Units Threshold Flagged Transactions, Summit County, OH 2006-2014

No. of Flagged Transactions	Oxycodone	Hydrocodone	Morphine	Hydromorphone	Oxymorphone	Other	Total
CVS	21,880	18,368	7,226	2,271	1,731	6,221	57,697
Discount Drug Mart	0	62	1,158	398	306	1,221	3,145
HBC / Giant Eagle	8,118	14,073	3,617	1,274	660	3,222	30,964
Rite Aid	16,583	11,853	4,192	1,154	969	3,227	37,978
Walgreens	29,185	6,270	10,156	3,704	1,525	4,954	55,794
Wal-Mart	1,556	0	474	164	99	484	2,777
Total	77,322	50,626	26,823	8,965	5,290	19,329	188,355

3. Three Times Trailing Twelve-Month Average Pharmacy Dosage Units

Table 38 Three Times Trailing Twelve-Month Average Pharmacy Dosage Units Threshold Flagged Transactions, Cuyahoga County, OH 2006-2014

No. of Flagged Transactions	Oxycodone	Hydrocodone	Morphine	Hydromorphone	Oxymorphone	Other	Total
CVS	12,948	6,453	2,522	322	1,282	8,874	32,401
Discount Drug Mart	0	0	514	98	0	2,227	2,839
HBC / Giant Eagle	0	0	0	20	0	1,537	1,557
Rite Aid	19,405	3,677	2,009	119	515	3,770	29,495
Walgreens	27,854	0	2,086	1,391	1,656	8,959	41,946
Wal-Mart	1,385	0	154	15	9	38	1,601
Total	61,592	10,130	7,285	1,965	3,462	25,405	109,839

Table 39 Three Trailing Twelve-Month Average Pharmacy Dosage Units Threshold Flagged Transactions, Summit County, OH 2006-2014

No. of Flagged Transactions	Oxycodone	Hydrocodone	Morphine	Hydromorphone	Oxymorphone	Other	Total
CVS	9,034	9,669	3,800	1,407	1,324	2,239	27,473
Discount Drug Mart	0	21	390	208	71	518	1,208
HBC / Giant Eagle	5,929	8,228	2,401	941	216	1,976	19,691
Rite Aid	9,980	2,895	3,074	925	774	1,093	18,741
Walgreens	15,672	0	2,247	1,579	668	1,942	22,108
Wal-Mart	313	0	458	158	36	381	1,346
Total	40,928	20,813	12,370	5,218	3,089	8,149	90,567

4. *Maximum 8,000 Dosage Units Monthly*

Table 40 Maximum 8,000 Dosage Units Monthly Threshold Flagged Transactions, Cuyahoga County, OH 2006-2014

No. of Flagged Transactions	Oxycodone	Hydrocodone	Morphine	Hydromorphone	Oxymorphone	Other	Total
CVS	50,282	61,480	0	0	0	0	111,762
Discount Drug Mart	13,464	20,375	0	0	0	0	33,839
HBC / Giant Eagle	6,877	50,434	0	0	0	0	57,311
Rite Aid	35,750	19,305	0	0	0	0	55,055
Walgreens	99,861	73,377	0	0	0	0	173,238
Wal-Mart	4,814	12,998	0	0	0	0	17,812
Total	211,048	237,969	0	0	0	0	449,017

Table 41 Maximum 8,000 Dosage Units Monthly Threshold Flagged Transactions, Summit County, OH 2006-2014

No. of Flagged Transactions	Oxycodone	Hydrocodone	Morphine	Hydromorphone	Oxymorphone	Other	Total
CVS	34,946	38,798	0	0	0	71	73,815
Discount Drug Mart	3,424	5,523	0	0	0	0	8,947
HBC / Giant Eagle	15,938	42,894	0	0	0	0	58,832
Rite Aid	18,618	20,304	0	0	0	0	38,922
Walgreens	42,349	42,821	0	0	0	0	85,170
Wal-Mart	1,345	6,806	0	0	0	0	8,151
Total	116,620	157,146	0	0	0	71	273,837

5. *Maximum Daily Dosage Units*

Table 42 Maximum Daily Dosage Units Threshold Flagged Transactions in Cuyahoga County, 2006-2014

No. of Flagged Transactions	Oxycodone	Hydrocodone	Morphine	Hydromorphone	Oxymorphone	Other	Total
CVS	63,914	96,391	11,355	1,753	n/a	7,237	180,650
Discount Drug Mart	18,246	26,801	3,023	202	n/a	381	48,653
HBC / Giant Eagle	21,554	74,603	382	24	n/a	1,238	97,801
Rite Aid	45,264	42,065	5,584	638	n/a	3,969	97,520
Walgreens	105,081	96,179	24,784	5,156	n/a	8,830	240,030
Wal-Mart	9,093	24,354	391	74	n/a	491	34,403
Total	263,152	360,393	45,519	7,847	n/a	22,146	699,057

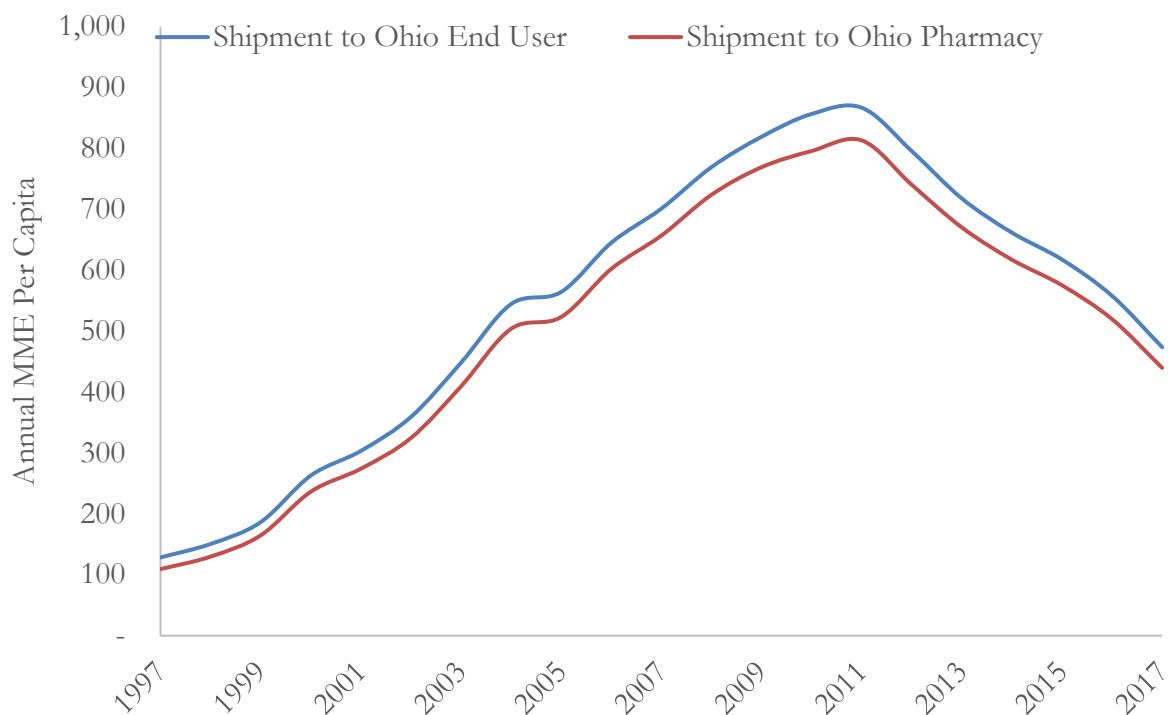
Table 43 Maximum Daily Dosage Units Threshold Flagged Transactions in Summit County, 2006-2014

No. of Flagged Transactions	Oxycodone	Hydrocodone	Morphine	Hydromorphone	Oxymorphone	Other	Total
CVS	36,542	41,052	9,946	2,592	n/a	2,020	92,152
Discount Drug Mart	6,050	6,849	1,692	245	n/a	170	15,006
HBC / Giant Eagle	20,496	51,934	3,737	873	n/a	594	77,634
Rite Aid	19,365	20,835	4,762	1,388	n/a	736	47,086
Walgreens	42,932	43,575	14,064	4,225	n/a	416	105,212
Wal-Mart	4,273	14,134	662	154	n/a	105	19,328
Total	129,658	178,379	34,863	9,477	n/a	4,041	356,418

X. Excessive Shipments

153. I plot total per capita opioid MMEs shipped into Ohio based on the public ARCOS Data from 1997 to 2017 in Figure 21. Figure 21 also includes per capita opioid MMEs shipped into Ohio pharmacies. Figure 22 and Figure 23 plot total per capita opioid MMEs shipped into 3-digit zip-codes which Cuyahoga County and Summit County encompass.⁵⁶

Figure 21 Per Capita Opioid MME in Ohio, 1997-2017



⁵⁶ARCOS Retail Drug Summary Reports report County and 3-digit zip-code information. Cuyahoga County and Summit County boundaries do not coincide precisely with 3-digit zip-code boundaries. These charts - and any other chart, figure or analysis at the County level using ARCOS Retail Drug Summary Reports - use the 3-digit zip-codes 441 for Cuyahoga County and 443 for Summit County.

Figure 22 Per Capita Opioid MME in Cuyahoga County, OH 1997-2017

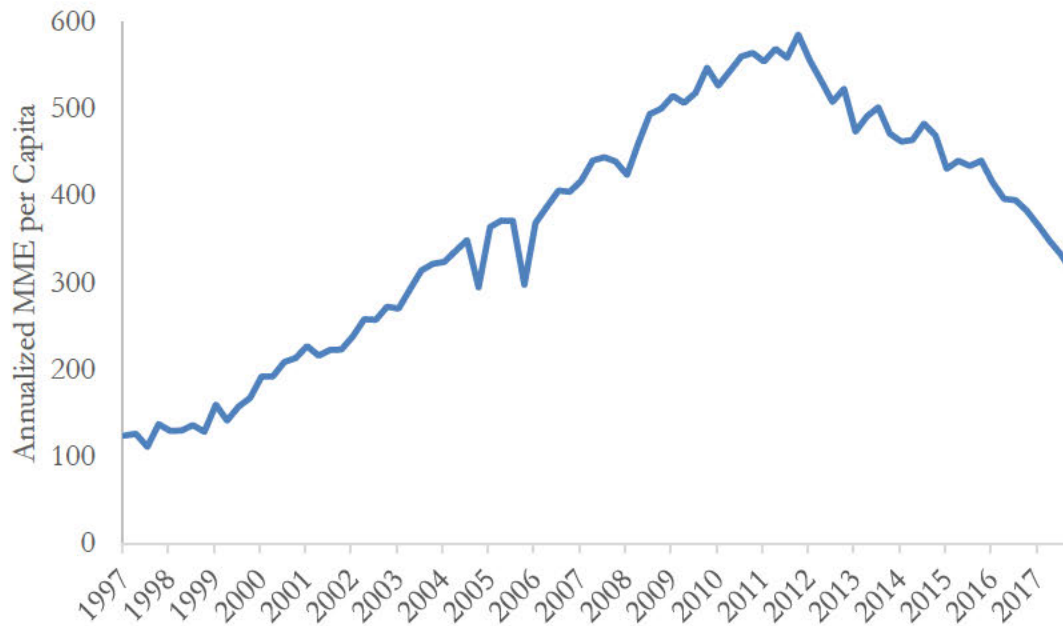
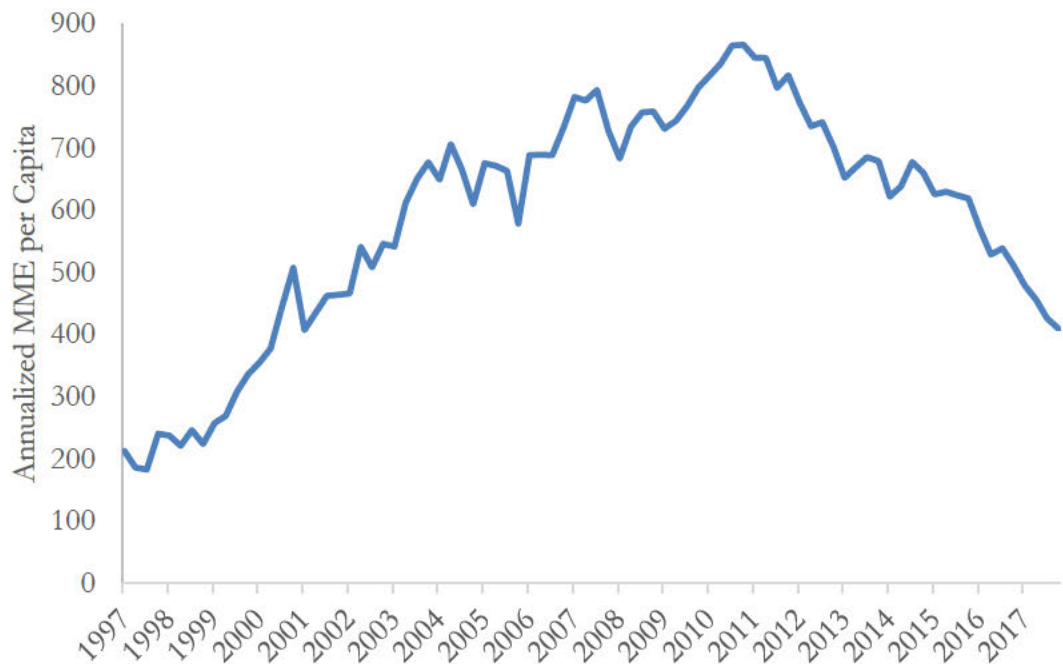


Figure 23 Per Capita Opioid MME in Summit County, OH 1997-2017



154. Figure 21, Figure 22 and Figure 23 illustrate a similar pattern. In Ohio and in Cuyahoga County and Summit County per capita opioid MME

increased from 1997 to 2010 and thereafter declined so that per capita opioid MME in 2017 was 3.7 times per capita opioid MME in 1997 in Ohio.

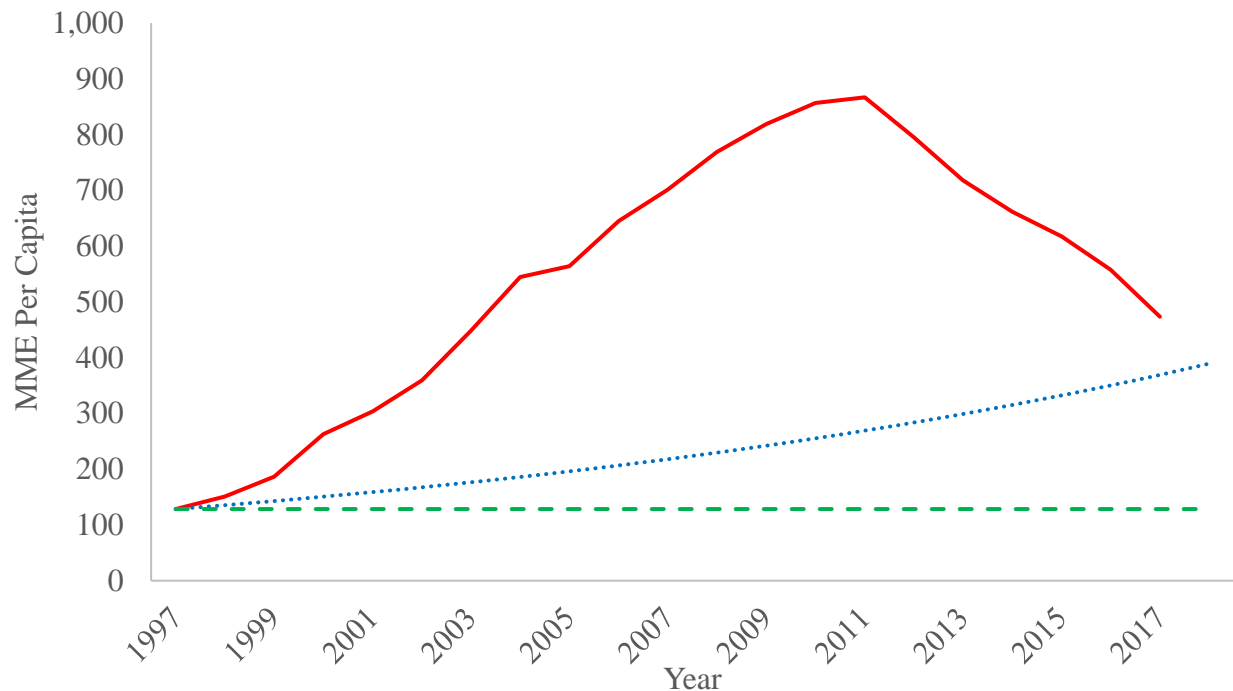
155. A possible upper bound on the medically necessary opioid MME per capita baseline is the per capita MME interpolated from 1997 to 2018. This baseline assumes that all prescriptions of opioids in 1997 and in 2018 were medically necessary and that the drivers of legitimate opioid use (eg. aging of the population) evolve gradually rather than discontinuously over time. Plaintiffs allege that opioid consumption in 2018 remained excessive and was still influenced by the Defendants' alleged fraudulent conduct.

156. A possible lower bound on the medically necessary opioid MME per capita baseline is the 1997 per capita MME. This baseline assumes that all prescriptions of opioids in 1997 were necessary and opioid use per capita beyond 1997 levels were unnecessary.

157. I plot these two baselines in Figure 24 along with the per capita MME shipped into Ohio from Figure 21.

Figure 24 Per Capita Opioid Actual and Baseline MME to Ohio, 1997-2018

— Actual MME Per Capita 1997-2018 Interpolated Baseline - - - 1997 Constant Baseline



158. The difference between the actual shipments of opioids into Ohio and the baseline is an estimate of the excessive opioids shipped into Ohio.

- Using the 1997-2018 interpolated baseline, 76.24 billion MME or 58.6% of the 130.18 billion total MME shipped into Ohio from 1998 to 2017 was excessive.
- Using the 1997 baseline, 100.66 billion MME or 77.3% of the 130.18 billion total MME shipped into Ohio was excessive. See Table 44.

Table 44 Excessive Opioid MME in Ohio

Year	Ohio MME (billions)	1997-2018 Interpolated			1997 Per Capita		
		Baseline			Baseline		
		Baseline	Excess	Excess%	Baseline	Excess	Excess%
1997	1.45	1.45	-		1.45	-	
1998	1.70	1.53	0.17	10.1%	1.45	0.25	14.7%
1999	2.11	1.62	0.50	23.4%	1.46	0.66	31.1%
2000	2.99	1.71	1.28	42.8%	1.46	1.53	51.1%
2001	3.45	1.81	1.65	47.7%	1.46	1.99	57.7%
2002	4.10	1.91	2.19	53.4%	1.47	2.63	64.2%
2003	5.12	2.02	3.11	60.7%	1.47	3.66	71.3%
2004	6.24	2.13	4.11	65.9%	1.47	4.76	76.4%
2005	6.47	2.25	4.22	65.3%	1.47	5.00	77.2%
2006	7.41	2.37	5.03	68.0%	1.47	5.93	80.1%
2007	8.06	2.50	5.56	68.9%	1.48	6.59	81.7%
2008	8.86	2.64	6.21	70.2%	1.48	7.38	83.3%
2009	9.44	2.79	6.65	70.5%	1.48	7.96	84.3%
2010	9.88	2.94	6.94	70.2%	1.48	8.40	85.0%
2011	10.01	3.11	6.90	69.0%	1.48	8.52	85.2%
2012	9.19	3.27	5.91	64.4%	1.48	7.70	83.9%
2013	8.30	3.46	4.84	58.4%	1.49	6.82	82.1%
2014	7.67	3.65	4.02	52.4%	1.49	6.18	80.6%
2015	7.17	3.86	3.31	46.2%	1.49	5.68	79.2%
2016	6.48	4.07	2.41	37.2%	1.49	4.99	77.0%
2017	5.52	4.30	1.22	22.0%	1.50	4.02	72.9%
2018 ⁵⁷		4.55			1.50		
1998-2017	130.18	53.94	76.24	58.6%	29.52	100.66	77.3%

159. Opioid dosage units dispensed in Ohio have declined 37% from 2012 to 2018. The percentage decline in dosage units dispensed in Ohio has increased each year suggesting that even the 2018 levels exceed the medically necessary level. My estimates of excessive opioid shipments into Ohio can be varied to reflect how much, if any, of the increase from 1997 to 2018 in per

⁵⁷ Estimated from the 2017 level reported in the RDSRs and 2018 decline from 2017 reported in Ohio Automated Rx Reports System, 2018 Annual Report, State of Ohio Board of Pharmacy, Section 1, Chart 1 available at [www.ohiopmp.gov/documents/Annual%20Report%20\(2018\).pdf](http://www.ohiopmp.gov/documents/Annual%20Report%20(2018).pdf)

capita opioid MME above the 1997 levels was medically justifiable. See Table 45.

Table 45 Excessive MME in Ohio and MME by % Increase From 1997 Per Capita MME That was Legitimate

% 1997-2018 Increase Legitimate	% Excessive in Ohio	
	1998-2017	2006-2014
100%	58.6%	66.1%
80%	62.3%	69.5%
60%	66.1%	72.9%
40%	69.8%	76.3%
20%	73.6%	79.7%
0%	77.3%	83.1%

- If 100% of the increase in opioids dispensed in Ohio in 2018 compared to the 1997 per capita level were medically necessary, 58.6% of the opioids dispensed from 1998 to 2017 and 66.1% of the opioids dispensed from 2006 to 2014 were excessive.
- If 80% of the increase in opioids dispensed in Ohio in 2018 compared to the 1997 per capita level were medically necessary, 62.3% of the opioids dispensed from 1998 to 2017 and 69.5% of the opioids dispensed from 2006 to 2014 were excessive.
- If 60% of the increase in opioids dispensed in Ohio in 2018 compared to the 1997 per capita level were medically necessary, 66.1% of the opioids dispensed from 1998 to 2017 and 72.9% of the opioids dispensed from 2006 to 2014 were excessive.
- If 40% of the increase in opioids dispensed in Ohio in 2018 compared to the 1997 per capita level were medically necessary,

69.8% of the opioids dispensed from 1998 to 2017 and 76.3% of the opioids dispensed from 2006 to 2014 were excessive.

- If 20% of the increase in opioids dispensed in Ohio in 2018 compared to the 1997 per capita level were medically necessary, 73.6% of the opioids dispensed from 1998 to 2017 and 79.7% of the opioids dispensed from 2006 to 2014 were excessive.
- If none of the increase in opioids dispensed in Ohio in 2018 compared to the 1997 per capita level were medically necessary, 77.3% of the opioids dispensed from 1998 to 2017 and 83.1% of the opioids dispensed from 2006 to 2014 were excessive.

160. My estimates of the percentage excessive shipments into Ohio in Table 45 - which average 71.3% - are a useful frame of reference for evaluating the transactions flagged by the methods in the previous subsections. For example, the Maximum Monthly Trailing 6-Month Threshold flagged 76.0% of transactions, 89.6% of dosage units and 73.5% of MME shipped to pharmacies in Cuyahoga County and 75.4% of transactions, 88.5% of dosage units and 71.4% of MME shipped to pharmacies in Summit County. The purpose of identifying transactions – to determine which transactions warrant some further due diligence – is likely to only be met by flagging more transactions than those which are used to fill medically unnecessary prescriptions. Thus, the decline in opioid use in Ohio and the implication that more than 70% of opioids shipped into Ohio were excessive, supports my identification of transactions.

XI. Charts and Reports

161. In addition to the Figures and Tables in the body of this report, I have created a set of Charts and Tables that are too voluminous to be displayed and discussed fully here in. Those additional Charts and Tables are attached in Appendix 9 and described generally in this section.

A. State Hydrocodone and Oxycodone MME Per Capita, 1997-2017

162. Using ARCOS data produced by the DEA for 2006-2014 and public ARCOS Retail Drug Summary Reports otherwise, I plot total hydrocodone and oxycodone MME per capita, by State from 1997 to 2017. There is one chart and a 2-page backup summary table for each hydrocodone and oxycodone.

163. In the two charts, the line reflecting Ohio MME per capita is highlighted using red. Kentucky, Indiana, Michigan, Pennsylvania, West Virginia are highlighted in purple, blue and orange respectively. The rest of the states are drawn in light grey.

164. The 2-page backup summary tables report hydrocodone and oxycodone MME per capita each year and averaged over the 1997-2017 period. The states are sorted by average MME per capita over the entire 21-year period.

B. All Defendants Combined and Individually - 12 Opioid Drug Distribution by Defendant

165. Using ARCOS data produced by the DEA for 2006-2014 and Defendant transaction data otherwise, I plot all Defendants' shipments of

twelve opioid drugs into Cuyahoga County and into Summit County from 1996 to 2018.

166. There are two versions of this chart for each County. One version is a stacked bar chart in which the height of a colored section of each bar corresponds to shipments by each Defendant according to the color-coded legend. The second version of the chart is a line graph in which each Defendant's shipments into each County is reflected by the same color-coding as the stacked bar chart.

C. All Defendants, Combined and Individually, 12 Opioid Drug Distribution by Drug Code

167. Using ARCOS data produced by the DEA for 2006-2014 and Defendant transaction data otherwise, I plot all Defendants' combined shipments of oxycodone, hydrocodone, codeine, fentanyl, morphine, hydromorphone and "other" opioid drugs into Cuyahoga County and into Summit County from 1996 to 2018 in dosage units. "Other" opioid drugs include dihydrocodeine, levorphanol, meperidine, oxymorphone, powdered opium, and tapentadol.

168. The stacked bar charts illustrate the dosage units of each drug identified in the color-coded legend. The vast majority of dosage units each year and in both Counties is in oxycodone and hydrocodone.

D. All Seller 12 Opioid Drug Distribution in MME, Cuyahoga County and Summit County, by Drug

169. Using public ARCOS Retail Drug Summary Reports, I plot all shipments of oxycodone, hydrocodone, codeine, fentanyl, morphine,

hydromorphone and “other” opioid drugs into Cuyahoga County and into Summit County from 1996 to 2017 in MME.

170. The stacked bar charts illustrate the MME of each drug identified in the color-coded legend. Measured by MME, most of the opioids shipped into both counties continues to be oxycodone but fentanyl is second followed by hydrocodone because of fentanyl’s much higher relative strength.

171. ARCOS Retail Drug Summary Reports report County and 3-digit zip-code information. Cuyahoga County and Summit County boundaries do not coincide precisely with 3-digit zip-code boundaries. These charts - and any other chart, figure or analysis at the County level using ARCOS Retail Drug Summary Reports - use the 3-digit zip-codes 441 for Cuyahoga County and 443 for Summit County.

E. Individual Defendant Oxycodone Distribution in OH by Total Dosage, Total MME, Total Drug Base Weight

172. Using ARCOS data produced by the DEA for 2006-2014 and Defendant transaction data otherwise, I plot each Defendants’ shipments of oxycodone into Cuyahoga County and into Summit County monthly in dosage units, MME and base weight. There are 84 charts – 14 Defendants, 2 counties, 3 measures.

F. Individual Defendant Hydrocodone Distribution by Total Dosage, Total MME, Total Drug Base Weight

173. Using ARCOS data produced by the DEA for 2006-2014 and Defendant transaction data otherwise, I plot each Defendants’ shipments of hydrocodone into Cuyahoga County and into Summit County monthly in

dosage units, MME and base weight. There are 84 charts (ie. 14 Defendants, 2 counties, 3 measures) of this type.

G. Oxycodone and Hydrocodone Distribution to Individual Pharmacies by Defendant

174. Using ARCOS data produced by the DEA for 2006-2014 and Defendant transaction data otherwise, I plot all Defendants' shipments of oxycodone and hydrocodone to each pharmacy that received hydrocodone in Cuyahoga County and in Summit County in dosage units. There are 1,716 charts of this type.

H. Pharmacy Reports

175. Using ARCOS data produced by the DEA for 2006-2014, I tabulate and report dosage units, MME and drug weight shipped to retail and chain pharmacies in Cuyahoga County and Summit County. I list the pharmacies in each county sorted by total MME. For each year, I report the dosage units and drug weight of oxycodone, hydrocodone, morphine, and codeine and the dosage units and MME of the twelve non-treatment drugs received by each pharmacy from each Distributor. For comparison purposes, I list the average pharmacy MME in the county and the state each year and each pharmacy's percentile rank by MME in the state each year.

176. The Pharmacy Report for Cuyahoga County is 1,250 pages long and Distributor Report for Summit County is 557 pages long.

I. Distributor Reports

177. Using ARCOS data produced by the DEA for 2006-2014, I tabulate and report the total Dosage Units per capita by year and by state. I

rank states by average dosage units per capita over the 2006-2014 period and plot the 25 states with highest average dosage units per capita.

178. I tabulate and report the total MME per capita by year and by state and rank states by average MME per capita over the 2006-2014 period and plot the 25 states with highest average MME per capita.

179. I tabulate and report the MME and Dosage Units each year and totaled over the 2006-2014 period and market shares over the 2006-2014 period for each Distributor. I further break down the Distributors' annual shipments and total shipments and market share over the 2006-2014 period into the Distributors' individual DEA numbers.

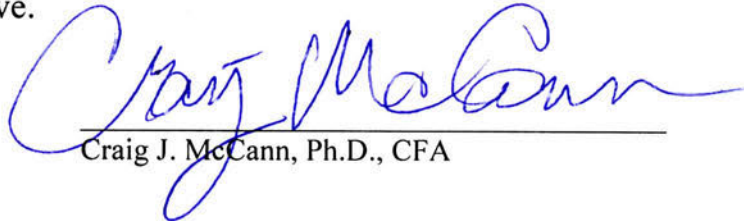
180. The Distributor Report for Cuyahoga County is 72 pages long and Distributor Report for Summit County is 63 pages long.

XII. Conclusion

181. Based upon my comparison of the ARCOS Data produced by the DEA, the public ARCOS Retail Drug Summary Reports and the Defendants transaction data, I conclude that - after correcting a relatively small number of records - the ARCOS Data produced by the DEA is complete and reliable.

182. I further conclude that Cardinal Health's transaction records produced in discovery are a reliable source of transactions data before 2006 and after 2014. More generally, with the exception of AmerisourceBergen, the other Defendants' transaction data is also a reliable source of transaction data for the periods covered by its production.

183. The ARCOS Data can be used to identify transactions into a state, county, zipcode or individual pharmacy meeting certain criteria as I have illustrated above.



Craig J. McCann, Ph.D., CFA

Appendix 1 Craig McCann Resume



Craig McCann, PhD, CFA Principal

CRAIGMCCANN@SLCG.COM

703-246-9381

Key Qualifications

Dr. McCann is Principal, Securities Litigation and Consulting Group, Inc. He is experienced in securities class action litigation, financial analysis, investment management and valuation. Dr. McCann has taught graduate investment management at Georgetown University and at the University of Maryland, College Park. He held a Series 7 and a Series 63 NASD. Dr. McCann is a Chartered Financial Analyst.



Dr. McCann received a B.A. and an M.A. in Economics from the University of Western Ontario and a Doctorate degree in Economics from the University of California, at Los Angeles. Dr. McCann's fields of graduate study were industrial organization, mathematical economics and information and uncertainty. His dissertation examined the incidence of golden parachutes and their effect on stock prices. After receiving his doctorate degree, Dr. McCann taught economics at the University of South Carolina.

Prior to founding Securities Litigation and Consulting Group, Dr. McCann was Director at LECG and Managing Director, Securities Litigation at KPMG. Dr. McCann was a senior financial economist at the Securities and Exchange Commission. There he focused on investment management issues and contributed financial analysis to numerous investigations involving alleged insider trading, securities fraud, personal trading abuses and broker-dealer misconduct.

Dr. McCann was a Senior Consultant at a consulting firm where he managed projects involving alleged securities fraud, insider trading, and market manipulation. These projects included analysis of materiality, causation, damages and class certification. In addition, he has consulted on transfer pricing, breach of contract, labor and antitrust cases as well as on various regulatory matters.

Dr. McCann has published in the *Alternative Investment Analyst Review*, *Financial Services Review*, *Investments & Wealth Monitor*, *Journal of Alternative Investments*, *Journal of Applied Corporate Finance*, *Journal of Asset Management*, *Journal of Business Valuation and Economic Loss Analysis*, *Journal of Computational Finance*, *Journal of Derivatives*, *Journal of Derivatives & Hedge Funds*, *Journal of Financial Transformation*, *Harvard Business Review*, *Journal of Index Investing*, *Journal of Investing*, *Journal of Legal Economics*, *Journal of Real Estate Portfolio Management*, *Journal of Retirement*, *Journal of Risk* and *Journal of Wealth Management*. He has testified in state and federal court, in NASD, NYSE, JAMS and AAA arbitration proceedings and before the United States Senate and has been quoted in the *New York Times*, *Wall Street Journal*, *Washington Post*, *Bloomberg Markets*, *Reuters*, *Boston Globe*, *Bond Buyer*, *American Banker*, *Money Magazine*, *Kiplinger Retirement Report*, and *Crain's Investment News*.

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Professional Experience

SECURITIES LITIGATION AND CONSULTING GROUP, INC.

2000 - *Principal*
Provides expert consulting and testifying in securities class actions, investment management, labor and valuation disputes.

NAVIGANT CONSULTING, INC. / LECG

1999-2000 *Director*
Provided expert consulting and testifying in complex litigation.

KPMG llp

1997-1999 *Managing Director, Securities Litigation*
Directed projects in complex litigation.

UNIVERSITY OF MARYLAND, COLLEGE PARK

1995-1998 *Adjunct Professor of Finance*
Taught graduate investment management.

GEORGETOWN UNIVERSITY

1996 *Adjunct Professor of Finance*
Taught graduate investment management.

NATIONAL ECONOMIC RESEARCH ASSOCIATES

1995-1997 *Senior Consultant*
Directed projects in the economics of complex securities litigation.

VIRGINIA TECH

1995-1997 *Adjunct Professor of Economics*
Taught graduate managerial economics.

U.S. SECURITIES AND EXCHANGE COMMISSION

1994-1995 *Professional Fellow and Acting Associate Chief Economist for Policy*
Reviewed Commission initiatives and coordinated research in support of Chief Economist.
Conducted research into portfolio performance, personal trading and quantitative risk measures.
Provided financial analysis in support of enforcement.

ECONOMIC ANALYSIS CORPORATION

1993-1994 *Senior Economist*
Directed projects involving analysis of vertical and horizontal practices, mergers, and general business damages.

U.S. SECURITIES AND EXCHANGE COMMISSION

1992-1993 *Academic Fellow*
Conducted research into the valuation and expensing of employee stock options, reviewed policy proposals and supported enforcement actions.

UNIVERSITY OF SOUTH CAROLINA, COLLEGE OF BUSINESS

1987-1992 *Assistant Professor*
Taught economics, antitrust and public policy towards business at undergraduate, masters, MBA and doctorate levels.

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Education

UNIVERSITY OF CALIFORNIA, LOS ANGELES

1989 Ph.D., Economics

1986 M.A., Economics

UNIVERSITY OF WESTERN ONTARIO

1983 M.A., Economics

1982 B.A., Economics

Chartered Financial Analyst

Series 7 NASD Registration (1997-1999)

Series 63 NASD Registration (1997-1999)

Professional Activities

American Economic Association

American Finance Association

Chartered Financial Analyst Institute

Washington Society of Investment Analysts

Testimony, Depositions, Reports and Affidavits**Federal Court***In Re National Prescription Opiate Litigation* United States District Court, Northern District of Ohio, Eastern Division, Case No. 17-MD-2804 (DAP).

Expert Report, March 25, 2019.

Gary and Caryl Luis et al v. RBC Capital Markets, LLC, United States District Court, District of Minnesota, Case No. 0:16-cv-3873-SRN-TNL

Deposition, February 21, 2019.

Expert Report, October 20, 2018.

Securities and Exchange Commission v. RPM International, Inc. et al, United States District Court, District of Columbia, Case No. 1:16-cv-01803 (ABJ)

Expert Report, November 2, 2018.

Peaker Energy Group, LLC et al v Cargill Incorporated et al, United States District Court Eastern District of Louisiana, Case No. 2:14-CV-02106.

Deposition, October 28, 2016.

Expert Report, August 5, 2016.

Ernest O. Abbit et al v ING USA Annuity and Life Insurance Company et al, United States District Court, Southern District of California, Case No: CV 05-6838

Declaration, April 7, 2016.

Deposition, March 13, 2015.

Expert Report, February 20, 2015.

Patsy Chambers, et al v North American Company for Life, United States District Court for the Southern District of Iowa Central Division, No. 4:11-CV-00579-JAJ-CFB

Reply Expert Report, April 22, 2015.

Deposition, February 27, 2015.

Supplemental Expert Report, January 30, 2015.

Expert Report, August 18, 2014.

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Deposition, July 29, 2014.
Expert Report, March 17, 2014.

Vida F. Negrete, et al v. Allianz Life Insurance Company, United States District Court, Central District of California, Case No: CV 05-6838

Declaration, November 1, 2013.
Deposition, May 1, 2012.
Expert Report, March 9, 2012.
Hearing Testimony, October 5, 2011.
Declaration, September 15, 2011.
Deposition, May 27, 2011.
Supplemental Declaration, March 31, 2011.
Deposition, October 29, 2008.
Declaration, July 25, 2008.
Second Supplemental Declaration, September 18, 2006.
Supplemental Declaration, July 16, 2006.
Declaration, May 26, 2006.

The Municipal Corporation of Bremanger, et al v Citigroup, Inc. et al, United States District Court, Southern District of New York, Civil Action, Civil Action No. 09-CV-7058.

Declaration, July 13, 2012.
Deposition, April 18, 2012.
Rebuttal Expert Report, March 28, 2012.
Expert Report, February 29, 2012.

Bank of America, N.A. v JB Hanna et al, United States District Court, Western District of Arkansas, Civil Action, Civil Action No. 10-5220

Deposition, April 16, 2012.
Expert Report, March 19, 2012.

In re: Federal Home Loan Mortgage Corp. (Freddie Mac) Securities Litigation, United States District Court, Southern District of New York, Civil Action 09-MD-2072 (MGC)

Hearing Testimony, October November December 2011.
Rebuttal Expert Report, September 14, 2011.
Deposition, August 2, 2011.
Expert Report, June 30, 2011.

Susan Antilla v. L. J. Alfrest & Co., Inc., United States District Court, District of Connecticut, No. 3:09-CV-2128-VLB.

Deposition, December 20, 2011.
Expert Report, August 12, 2011.

In re : International Management Associates, LLC, United States Bankruptcy Court, Northern District of Georgia, Atlanta Division, Case No. 06-62966.

Declaration, December 16, 2011.
Expert Report, July 7, 2011.

Thomas Todd Martin, III et al v Wachovia Bank, NA et al, United States District Court, Northern District of Alabama, Case No.: CV-09-902464

Expert Report, June 17, 2011.

Corporate America Credit Union v Joseph Herbst, et al, United States District Court, Northern District of Alabama, Case No.: CV-09-J-2126-S

Rebuttal Expert Report, May 23, 2011.

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Pierra-Sonora Enterprises, Inc. et al v Domino's Pizza, LLC et al, United States District Court, District of Arizona, NO. 2:10-cv-00105-JAT

Expert Report, August 24, 2010.

Houston Police Officer's Pension System v. State Street Bank and Trust Company and State Street Global Advisors, Inc. United States District Court, Southern District of Texas, Houston Division, No. 08-05442-RJH

Declaration, July 1, 2010.

Deposition, May 10, 2010.

Rebuttal Expert Report, March 19, 2010.

Expert Report, January 15, 2010.

Akanthos Capital Management, LLC, et al. v CompuCredit Holdings Corporation, United States District Court, Northern District of Georgia, Atlanta Division, No. 1:10-CV-844-TCB

Declaration, May 7, 2010.

Securities and Exchange Commission v. Kederio Ainsworth et al, United States District Court, central District of California, Eastern Division, Civil Action No. EDCV08-1350 VAP(OPx)

Deposition, February 2, 2010.

Supplemental Expert Report, January 5, 2010.

Expert Report, December 11, 2009.

Florence Smith v National Western Life Insurance Company United States District Court, Middle District of Pennsylvania, Civil Action no. 08-2119

Expert Report, January 4, 2010.

City of Cedar Rapids and Cedar Rapids/Linn county Solid Waste Agency v. Wells Fargo Brokerage Services, LLC. United States District Court, Northern District of Iowa, Cedar Rapids Division, No. ____

Rebuttal Expert Report, December 2, 2009.

Expert Report, September 3, 2009.

Daniel G. Schmidt, III v Wachovia Bank, N.A. United States District Court, Southern District of Texas, Houston Division, No. 08-05442-RJH

Deposition, February 25, 2010.

Expert Report, October 30, 2009.

In Re Midland National Insurance Co. Annuity Sales Practices Litigation, United States District Court, Central District of California, No. MDL No. 07-1825 CAS (MANx).

Deposition, September 12, 2009.

Supplemental Declaration, June 19, 2009.

Deposition, January 8, 2008.

Declaration, October 31, 2007.

Deposition, July 27, 2007.

Declaration, July 16, 2007.

Declaration, July 2, 2007.

Declaration, June 29, 2007.

Securities and Exchange Commission v. Biosail Corporation et al, United States District Court, Southern District of New York, Civil Action No. 08 CIV 02979 (LAK)

Expert Report, July 2, 2009.

CountryMark Cooperative, LLP, v Morgan Keegan & Company, Inc., United States District Court, Southern District of Indiana, Case No: 1:08-cv-00118-RLY-JMS

Expert Report, April 6, 2009.

Amy J. Straily et al v UBS Financial services, Inc., United States District Court, District of Colorado, Case No: 07-cv-00884-REB-KMT

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Deposition, February 22, 2009.
Supplemental Expert Report, January 16, 2009.
Expert Report, January 16, 2009.

Securities and Exchange Commission v. Competitive Technologies, et al, United States District Court, District of Connecticut, Civil Action No. 304-CV-1331 JCH.
Trial Testimony, October 7, 2008.
Trial Testimony, November 15, 2007.
Deposition, February 22, 2006.
Expert Report, January 30, 2006.

In Re American Equity Annuity Practices and Sales Litigation, United States District Court, Central District of California, No. MDL No. CV-05-6735-CAS (MANx).
Deposition, July 24, 2008.
Declaration, April 21, 2008.

In re Alstom SA Securities Litigation, United States District Court, Southern District of New York, Case No: 03-CV-6595 (VM).
Affidavit, January 4, 2008.

Vida F. Negrete, et al v. Fidelity and Guaranty Life Insurance Company, United States District Court, Central District of California, Case No: CV 05-6837.
Declaration, January 22, 2008.
Declaration, December 26, 2007.
Deposition, August 28, 2007.
Declaration, July 23, 2007.

Yousin (Kevin) Ma et al v Merrill Lynch & Co., Inc. and Irene S. Ng, United States District Court, Southern District of New York, Case No. 06 CV 15497.
Expert Report, December 24, 2007.

Dale Sakai v Merrill Lynch Life Insurance Company, United States District Court, Northern District of California, Case No: CV 06-2581.
Deposition, December 10, 2007.
Expert Report, October 26, 2007.

Securities and Exchange Commission v. Louis E. Rivelli, et al, United States District Court, District of Colorado, Civ. 05-CV-1039 RPM-MJW
Deposition, March 3, 2008.
Expert Report, October 8, 2007.

Kevin Lamkin, et al v. UBS PaineWebber, Inc., United States District Court, Southern District of Texas, Civil Action No. H-02-0851
Deposition, February 28, 2007.
Expert Report, June 1, 2006.

Carmen Migliaccio, et al. v. Midland National Life Insurance Company, United States District Court, Central District of California, Case No: CV 05-6838.
Deposition, February 13, 2007.
Declaration, December 28, 2006.

Gary Yokoyama, et al. v. Midland National Life Insurance Company, United States District Court, District of Hawaii, Case No. 05-00303 MS KSC.
Deposition, November 20, 2006.
Declaration, November 10, 2006.
Declaration, May 4, 2006.

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Samuel Cooper, et al v. Pacific Life Insurance Company et al, United States District Court, Southern District of Georgia, Case No. CV 203-131

Deposition, September 12, 2006.

Expert Report, July 5, 2006.

United States of America v. Jamie Olin, United States District Court, Southern District of Texas, Criminal Number H-03-217.

Expert Report, December 23, 2005.

David Henderlight and Christine Henderlight v. AmSouth Bank, United States District Court, Eastern District of Tennessee, Knoxville Division Civil Action No: 3:02-CV-169.

Deposition, July 7, 2005.

Expert Report, January 18, 2005.

United States of America v. Bernard J. Ebbers United States District Court, Southern District of New York, Docket S4 02 Cr. 1144 (BSJ).

Expert Report June 8, 2005.

In Re: Kaiser Group International, Inc. et al, United States Bankruptcy Court for the District of Delaware, Case Nos. 00-2263 to 00-2301 (MPW).

Declaration, May 29, 2005.

United States of America v. Shawn P. McGhee United States District Court, District of Eastern Virginia, Docket 04-495.

Expert Report March 4, 2005.

Walnut Capital Partners et al. v Key Bank / McDonald Investments, Inc., United States District Court, Western District of Pennsylvania, Case No. 03-CV-0284.

Affidavit, February 14, 2005.

Deposition, September 8, 2004.

Supplemental Expert Report July 2, 2004.

Expert Report June 1, 2004.

Securities and Exchange Commission v. David Gane et al United States District Court, Southern District of Florida Miami Division, Civil Action No:03-61553.

Trial Testimony, December 10, 2004.

Deposition August 2, 2004.

Expert Report July 20, 2004.

Simon Falic et al v Legg Mason Wood Walker, Inc., United States District Court, Southern District of Florida, West Palm Beach Division Civil Action No. 03-80377.

Expert Report, October 19, 2004.

Securities and Exchange Commission v. David W. Butler United States District Court, Western District of Pennsylvania, Civil Action No. 00-1827.

Trial Testimony September 21, 2004.

Expert Report January 9, 2003.

Deposition, October 26, 2001.

Expert Report October 15, 2001.

United States of America v. Franklin C. Brown United States District Court, Middle District of Pennsylvania CR-02-146-02.

Trial Testimony, August 6, 2004.

Expert Report July 19, 2004.

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United States of America v. Jeffrey R. Anderson United States District Court, District of Eastern Virginia, Docket 1:03-CR-444.

Expert Report January 2, 2004.

United States of America v. Scott H. Miller United States District Court, District of Eastern Virginia, Docket No. 03-443-A.

Expert Report December 3, 2003.

In re: World Access, Inc. Securities Litigation, United States District Court, Northern District of Georgia Atlanta Division, 1:99-CV-0043-ODE.

Rebuttal Expert Report August 8, 2003.

Expert Report June 27, 2003.

In re: Pediatric Services of America, Inc. Securities Litigation, United States District Court, Northern District of Georgia Atlanta Division.

Expert Report November 19, 2001.

Affidavit, October 13, 2000.

United States of America v. Paul F. Polishan United States District Court, Middle District of Pennsylvania No.3: CR-96-274.

Trial Testimony November 15, 2001.

Expert Report November 5, 2001.

Kantishna Mining Company, Inc. et al v. Gail Norton et al United States District Court, District of Alaska F98-007 CV.

Declaration, June 1, 2001.

Expert Report and Declaration, April 17, 2001.

H. James Griggs et al v. Pace American Group, Inc., Coopers & Lybrand L.L.P., et al United States District Court, District of Arizona.

Trial Testimony, March 13, 2001.

Deposition, December 4, 2000.

Expert Report, November 14, 2000.

David Lesser, et al v. Quadramed Corporation United States District Court, District of Eastern Virginia No: 00 Civ. 606-A.

Expert Report, September 8, 2000.

John Tenaglia and The Tenaglia Family Partnership v. A.F. Best Securities et al, United States District Court, Southern District of Florida.

Expert Report, March 31, 2000.

UMG Recordings, Inc. et al v. MP3.com, Inc., United States District Court, Southern District of New York, No:00 Civ. 0472.

Expert Report, August 8, 1999.

Jonathan Bekhor et al v. Josephthal Holdings et al, United States District Court, Southern District of New York, No: 96 Civ. 4156.

Deposition, September 30, 1999.

Expert Report, August 20, 1999.

John Shane and Beth Goodman v. Tokai Bank, United States District Court, Southern District of New York, No:96 Civ. 5187.

Trial Testimony, October 23, 24 1997.

Deposition, October 19, 1997.

Expert Report, October 18, 1997.

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State Court

Wayne Harwell v Texas Next Capital, L.P., et al District Court, Bexar County, Texas, 166th Judicial District, Case No. 2017CI03737
Expert Report, February 21, 2019.

In Re: Lawrence J. and Florence A. DeGeorge Charitable Trust et al v Lawrence F. DeGeorge et al,
In the Circuit Court of the 15th Judicial Circuit in and for Palm Beach County, Probate
Division, Case No. 502012CP004397XXXXMB
Trial Testimony, August 21, 2017.

Douglas Ballinger, et al v Regions Investment Management Inc. et al In the Sixth Circuit Court of
Tennessee for the Twentieth Judicial District at Nashville.
Deposition, April 26, 2017.
Expert Report, March 8, 2017.

Travis A. Medve v JP Morgan Chase Bank, N.A., et al, In the District Court of Harris
County, Texas, 61st Judicial District, Cause No. 2015-38122
Deposition, February 24, 2017.
Expert Report, December 5, 2016.

Jack Loperena v Steve Antry, et al, In the District Court of Tulsa County, State of Oklahoma
CJ-2013-03058
Trial Testimony, June 10, 2016.
Deposition, November 4, 2015.

Roberta Mell v Resnick Investment Advisors, LLC Superior Court, Judicial District of
Stamford/Norwalk State of Connecticut, CV 13-60192015
Deposition, March 11, 2016.
Expert Report, November 3, 2015.

Frances Brilliard, et al v Morgan Asset Management Inc. et al In the Circuit Court of Tennessee
for the Thirteenth District at Memphis, Shelby County, Case No: DC-09-14448.
Deposition, February 20, 2015.
Expert Report, January 2, 2015.

Purdue Avenue Investors L.P. et al v Morgan Keegan & Co. Inc, et al, In the District Court,
Dallas County, Texas, 101st Judicial District, Case No: DC-09-14448.
Trial Testimony, October 16, 2014.
Deposition, August 22, 2014.
Expert Report, July 15, 2014.

Francis P. Maybank v BB&T Corporation, et al, State of South Carolina, County of Greenville,
Court of Common Pleas, C.A. No. 2011-CP-23-8578.
Trial Testimony, June 19, 2014.
Deposition, February 7, 2014.

Robert L. McDonald v Camarind, Mogey & Fife et al, In The Court of Common Pleas of
Allegheny County, Pennsylvania, Case No. CD-11-016862.
Expert Report, July 11, 2013.

Commonwealth v. Brett B. Weinstein, Esquire, et al No. 239 M.D. 2006, *Commonwealth v. Estate
Planning Advisors Corp, et al* No. 740 M.D. 2004, and *Commonwealth v. Brett B. Weinstein,
Esquire, et al* No. 576 M.D. 2001, Commonwealth Court of Pennsylvania.
Expert Report, April 8, 2013.

Craig J. McCann
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Firefighters Retirement System v Regions Bank et al, State of Louisiana, Nineteenth Judicial District Court for the Parish of East Baton Rouge, Docket No. 56874, Division 25.

Expert Report, November 1, 2012.

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C. Randall Lewis, Receiver v. Steve Taylor, District Court, Denver County, Co., Case No. 2011CV2071.

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Dr. McCann has been invited to speak on prudent investment management practices, financial analysis in securities arbitrations, securities class action lawsuits and antitrust litigation on more than 65 continuing legal education and conference panels around the country.

March 25, 2019

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Appendix 2 Corrections to the ARCOS Data

184. Beginning in Table 5, I exclude certain transactions in the ARCOS Data and make corrections to other transactions in the ARCOS Data.

185. I make eight types of changes:

- a. I exclude duplicate transactions, when the same transaction was reported to ARCOS more than once by the same registrant.
- b. I exclude transactions where the Drug Code from the NDC dictionary is not one of the 14 opioids listed in Table 1.
- c. I exclude transactions where the Action Indicator code, Correction Number, or both suggest the reported transaction is erroneous.
- d. I exclude all transactions involving reverse distributors, analytical labs, importers, exporters, or researchers, because they are not relevant to my analysis. In addition, reverse distributors overstate the quantity of opioids shipped for destruction.
- e. I exclude transactions between two registrants, when the transaction is reported by the registrant receiving the shipment, because the transaction was already reported to ARCOS by the registrant sending the shipment.
- f. I exclude transactions with obvious errors in the reported Quantity.
- g. I exclude transactions with Transaction Code “X” (Lost-in-Transit), because “Transaction Code X is an explanatory

transaction code which does not affect an ARCOS registrant's inventory."⁵⁸

- h. I correct the Calculated Base Weight In Grams when it was calculated using an incorrect Ingredient Base Weight from the NDC dictionary.

A. Duplicate Transactions

1. Cardinal Health

186. The ARCOS Data had 610,381 duplicate transactions in December 2007 for one of the Cardinal Health distribution centers (Seller DEA Number: RC0221236). I removed one of each pair of exact duplicate transactions so that there was only one record of each transaction.

2. Walmart

187. The ARCOS Data had 390 duplicate transactions in August 2013 for two of Walmart's distributors (DEA #: RW0165731 and RW0199908). I removed one of each pair of exact duplicate transactions so that there was only one record of each transaction.

3. Discount Drug Mart

188. The ARCOS Data had 277 duplicate transactions in September 2014 for one of Discount Drug Mart's distributors (DEA #: PD0203377). I removed one of each pair of exact duplicate transactions so that there was only one record of each transaction.

⁵⁸ ARCOS Handbook, §5.8.3, p. 5-19.

B. NDC Dictionary

189. Three of the fields in the ARCOS Data (NDC, Drug Code, and Drug Name) can also be found in the NDC Dictionary.⁵⁹ I checked the accuracy of the Drug Code and Drug Name in the ARCOS Data by comparing those fields to the information in the NDC Dictionary.⁶⁰ When the two sources listed different Drug Codes or Drug Names, I updated the ARCOS Data to reflect the information in the November 2018 NDC Dictionary because the NDC Dictionary is updated monthly and I observe the DEA correcting errors in the NDC Dictionary. As a result of the comparison, I updated the Drug Code and Drug Name in 1,729 reported transactions (less than 0.0001% of the transactions).

190. After confirming the accuracy of the Drug Codes and Drug Names in the ARCOS Data, I found and removed 1,664 transactions (less than 0.0001% of the transactions) reported in the ARCOS Data which did not include any of the fourteen opioids in Table 1.

⁵⁹ The DEA's NDC dictionary is available at www.deaiversion.usdoj.gov/arcos/ndc/ndcfile.txt. The dictionary is explained at www.deaiversion.usdoj.gov/arcos/ndc/readme.txt. The DEA updates the NDC dictionary monthly to correct errors, add new drug products, and remove discontinued drug products. I used the NDC dictionary updated on November 1, 2018, plus any discontinued drug products from earlier versions of the NDC dictionary in May 2018 – October 2018. An alternative NDC dictionary is maintained by the FDA (www.accessdata.fda.gov/scripts/cder/ndc/index.cfm).

⁶⁰ I matched the ARCOS Data to the NDC Dictionary using NDC. For the Drug Code, I compared the first four digits of the Drug Code in the ARCOS Data to the first four digits of the Drug Code in the DEA's NDC dictionary. 156 NDCs in the ARCOS Data were not in the DEA's NDC dictionary.

191. I also checked the accuracy of Calculated Base Weight in Grams in the ARCOS Data and found some NDCs for which the ARCOS Data incorrectly reported the Calculated Based Weight in Grams because it relied on an incorrect Ingredient Base Weight in the NDC Dictionary.⁶¹ I reviewed the Ingredient Base Weights in the NDC Dictionary for all NDCs with Dosage Units in the ARCOS Data and flagged Ingredient Base Weights as potentially incorrect if the weight of the drug per dosage form (e.g., capsule, tablet, patch) was significantly different than other drug products with the same base drug and dosage strength.

192. For example, the NDC Dictionary reported that NDC 00056012770 (Percocet 5 mg tablets) contains 0.4483 milligrams of oxycodone per 100 tablets (0.004483 milligrams per tablet). Given other data in the NDC Dictionary, it is apparent that each 5-milligram tablet has 4.483 milligrams of drug.⁶² I concluded that this NDC's Ingredient Base Weight in the NDC Dictionary and Calculated Base Weight in Grams in the ARCOS Data should be 1,000 times larger, and accordingly increased the Calculated Base Weight in Grams for this NDC.

193. I corrected the Calculated Base Weight in Grams of 14 NDCs in 285,891 reported transactions (approximately 0.06% of the reported

⁶¹ Calculated Base Weight in Grams is a function of the Quantity, Unit, and Strength fields in the ARCOS Data, and the Ingredient Base Weight in the NDC Dictionary.

⁶² The drug's Ingredient Base Weight (e.g., 448.3 mg per 100 tablets) does not match the dosage strength (e.g., 500 mg per 100 tablets) because the Ingredient Base Weight is presented in terms of the anhydrous base form of the drug, while the dosage strength is presented in terms of the salt form of the drug. *See* p. 6-3 and Appendix 3 of the ARCOS Handbook.

transactions).⁶³ The DEA's NDC Dictionary also includes the trade name of the drug product ("Trade/Product Name") and the dosage form ("Package Measure"), which I added to the ARCOS Data.

194. Finally, I checked the accuracy of the Dosage Unit in the ARCOS Data by using the NDC Dictionary. I multiplied the Quantity in the ARCOS Data by the Package Quantity in the NDC Dictionary. I did not find any discrepancies.

C. Erroneous Transactions

195. I found and corrected four categories of erroneous transactions in the ARCOS Data.

1. *Transactions where ACTION_INDICATOR and CORRECTION_NO are both populated.*

196. The ARCOS Handbook explains that both the Action Indicator and Correction Number fields should never be populated for the same transaction. I found and deleted 59,223 such erroneous transactions (approximately 0.01% of the transactions).⁶⁴

2. *Adjustments to previously reported transactions.*

197. Reporters can adjust a previously reported transaction by submitting an adjusted transaction to ARCOS with ACTION_INDICATOR="A" and submitting a deletion request for the

⁶³ Subsequent versions of the DEA's NDC dictionary appear to have been updated to correct the errors I found. Thus, each version of the DEA's NDC dictionary should be evaluated separately for necessary drug weight corrections.

⁶⁴ See ARCOS Handbook, §7.4, p. 7-5.

originally reported transaction.⁶⁵ I identified 483,885 instances where the ARCOS Data included an adjusted transaction and either the originally reported transaction, the deletion request, or both.⁶⁶ I deleted the deletion request and the originally reported transaction.

3. *Deletions of previously reported transactions.*

198. Reporters can delete a previously reported transaction from ARCOS by re-submitting the transaction with ACTION_INDICATOR="D."⁶⁷ I identified 2,492 instances where the ARCOS Data included the deletion request and the original reported transaction.⁶⁸ I deleted the original transaction and the deletion request.

4. *Corrections of previously reported transactions.*

199. Reported transactions are sometimes rejected by ARCOS. The Reporter can then re-submit the transaction as a correction transaction. Correction transactions are identified by a record identifier in the CORRECTION_NO field.⁶⁹ I identified 17,320 instances where the ARCOS

⁶⁵ See ARCOS Handbook, §5.9.2, p. 5-20; §7.5.1, p. 7-13; and §7.8.2, p. 7-19.

⁶⁶ I identified the original record by matching the Reporter DEA Number, the Buyer DEA Number, the transaction month and year, the Drug Code, and the Transaction ID.

⁶⁷ See ARCOS Handbook, §5.9, pp. 5-19 through 5-20, and §7.5.1, p. 7-12.

⁶⁸ I identified the original record by matching the Reporter DEA Number, the Buyer DEA Number, the Transaction ID, the Transaction Date, the Order Form Number, the NDC, and the Quantity.

⁶⁹ See ARCOS Handbook, §5.16, p.5-42 and §7.5, pp. 7-12 through 7-15.

Data included both the rejected transaction and the corrected transaction. I kept the corrected transaction and deleted the originally reported transaction.⁷⁰

D. Transactions Involving Reverse Distributors, Analytical Labs, Importers, Exporters or Researchers

200. Reverse distributors, manufacturers and distributors ship opioids to analytical labs for destruction. Usually, manufacturers and distributors ship the opioids to the reverse distributors, who then ship them to the analytical labs. However, manufacturers and distributors sometimes ship opioids directly to analytical labs. Opioids shipped to reverse distributors or analytical labs are virtually never subsequently shipped to Dispensers.⁷¹ I exclude transactions in the ARCOS Data involving reverse distributors or analytical labs because my analysis is focused on the flow of opioids to Dispensers.

201. In addition, a number of transactions reported by reverse distributors have astronomical Calculated Base Weight in Grams either because the Unit code, used to specify the Quantity's unit of measurement, is set for kilograms when the most likely unit is milligrams for most opioids or micrograms for fentanyl, or because the Quantity itself is astronomical. For example, one pair of transactions reported by a reverse distributor in Georgia includes a receipt (coded P) of 45,902 metric tons of morphine from a manufacturer and a matched shipment for destruction (coded Y) to an analytical lab in Florida. In total, the ARCOS Data reflects 539,839 metric tons of opioids being shipped to analytical labs for destruction.

⁷⁰ I identified the original record by matching the Reporter DEA Number, the Buyer DEA Number, the transaction month and year, the Drug Code, and the Transaction ID.

⁷¹ The ARCOS Data reports 23,275 grams (Calculated Base Weight) of opioids were shipped from reverse distributors to Dispensers.

202. The ARCOS Data reports a relatively small quantity of opioids (91.3 metric tons of Calculated Base Weight) being sent to importers, exporters or researchers. I exclude transactions in the ARCOS Data involving importers, exporters or researchers because my analysis is focused on the flow of opioids to Dispensers.

E. Transactions between ARCOS Registrants

203. Transactions between ARCOS registrants should be reported twice in the ARCOS Data, once by each registrant. For example, a shipment from a manufacturer to a distributor should be reported once by the manufacturer and once by the distributor. To avoid double-counting, I keep the transaction reported by the registrant sending the shipment, and exclude the transaction reported by the registrant receiving the shipment.

F. Transactions with Obvious Errors in Quantity

204. I also exclude transactions with obvious errors in Quantity. For example, I exclude a single sale transaction of Hydrocodone/APAP tablets from a distributor to a practitioner in the Northern Mariana Islands that has a Calculated Base Weight of 34 metric tons.

G. Transaction Code “X”

205. I exclude all transactions with Transaction Code “X”. The ARCOS Handbook explains that this code “is used by the seller to report the loss or theft of an in-transit shipment of a reportable controlled substance. It is reported **in addition** to the normal sales transaction (transaction code S).

Transaction code X is an **explanatory** transaction code which does not affect an ARCOS registrant's inventory."⁷²

206. Table 46 summarizes the effect of my exclusions and corrections on the number of transactions and the total Calculated Base Weight in Grams in the ARCOS Data.

Table 46 Exclusions and Corrections to the ARCOS Data

	Change in # of Transactions	Change in Calculated Base Weight
Exclude Duplicate Transactions		
Cardinal Health Distributor, Dec. 2007 (DEA: RC0221236)	(610,381)	(1,747,195)
Walmart Distributors, Aug. 2013 (DEA: RW0165731 and RW0199908)	(390)	(540)
Discount Drug Mart Distributor, Sep. 2014 (DEA: PD0203377)	(277)	(1,097)
Total Duplicate Transactions	(611,048)	(1,748,832)
Exclude Irrelevant Drug Codes	(1,664)	(53)
Exclude Erroneous Transactions		
Action Indicator and Correction No. Both Populated	(59,223)	(69,513,829)
Adjustments to Previous Transactions	(483,885)	(26,215,303)
Deletions of Previous Transactions	(2,492)	(2,218,380)
Corrections of Previous Transactions	(17,320)	(1,715,081)
Total Erroneous Transactions	(562,920)	(99,662,593)
Exclude Transactions Involving Reverse Distributors, Analytical Labs, Importers, Exporters or Researchers	(45,398,192)	(1,083,219,607,303)
Exclude Double-Reporting of Transactions between Registrants	(14,508,254)	(8,671,652,671)
Exclude Transactions with Obvious Errors in Quantity	(1)	(34,053,752)

⁷² ARCOS Handbook, §5.8.3, p. 5-19 (emphasis in original).

Exclude Transaction Code "X"		
(Lost-in-Transit)	(3,729)	(116,009)
Fix Calculated Base Weight in Grams	-	(183,394,936)
<hr/>		
Total Effect of Exclusions and Corrections	(61,085,808)	(1,092,210,236,149)

Appendix 3: Frequency and definition of transaction codes

Transaction Code	% of Transactions	Impact on Inventory	Description
S	88.43%	-	Sale, Disposition, or Transfer
Y	3.84%	-	Destroyed
Z	0.00%	-	Receipt by Government (seizures, samples, etc.)
Q	0.00%	-	Sampling (manufacturers only)
K	0.00%	-	Used in Preparations (manufacturers only)
N	0.00%	-	Nonrecoverable Waste (manufacturers only)
P	7.14%	+	Purchase or Receipt
R	0.55%	+	Return
V	0.03%	+	Unsolicited Return
G	0.00%	+	Government Supplied
L	0.00%	+	Reversing (manufacturers only)
M	0.00%	+	Manufactured (manufacturers only)
W	0.00%	+	Recovered Waste (manufacturers only)
J	0.00%	+	Return of Sample to Inventory (manufacturers only)
X	0.00%	n/a	Lost-in-Transit

Appendix 4: Corrections to DEA's NDC Dictionary

NDC	Ingredient Base Weight in Grams in NDC Dictionary	Corrected Ingredient Base Weight in Grams
00603388228	136.215000	0.136215
00781560210	0.000892	4.460500
00056012770	0.000448	0.448300
00591245401	3,586.000000	3.586000
005913578**	0.000001	0.004500
107020184**	2.241250	0.002241
27280BH5701	0.570000	0.057000
52493019110	0.003020	0.030200
674330154**	0.000026	0.003027
674330888**	0.000705	0.021363
000440623**	0.000024	0.023900
00062A01628	0.695094	0.397197
00062A03228	0.695094	0.794394
000540438**	0.580400	290.200000

Appendix 5: List of Labeler Company Families

Labeler Company Family	Labeler Name	NDC Labeler Code
A Refreshing Discovery Inc	A Refreshing Discovery Inc	51130
Abbott Laboratories	Abbott Laboratories	00044
Abbott Laboratories	Abbott Laboratories	00048
AbbVie Inc.	AbbVie Inc.	00032
AbbVie Inc.	AbbVie Inc.	00074
Aber Pharmaceuticals, LLC	Aber Pharmaceuticals, LLC	67523
Accord Healthcare Inc.	Accord Healthcare Inc.	16729
Actavis Pharma, Inc.	Actavis Kadian LLC	46987
Actavis Pharma, Inc.	Actavis Pharma, Inc.	00228
Actavis Pharma, Inc.	Actavis Pharma, Inc.	00472
Actavis Pharma, Inc.	Actavis Pharma, Inc.	00591
Actavis Pharma, Inc.	Actavis Pharma, Inc.	45963
Actavis Pharma, Inc.	Actavis Pharma, Inc.	52544
Actavis Pharma, Inc.	Actavis Pharma, Inc.	62037
Actavis Pharma, Inc.	Actavis South Atlantic LLC	67767
Actavis Pharma, Inc.	Actavis Totowa LLC	52152
Acura Pharmaceuticals, Inc.	Acura Pharmaceuticals, Inc.	48964
Advanced Pharma, Inc.	Advanced Pharma, Inc.	15082
Aidarex Pharmaceuticals LLC	Aidarex Pharmaceuticals LLC	33261
Aidarex Pharmaceuticals LLC	Aidarex Pharmaceuticals LLC	53217
Akorn, Inc.	Akorn, Inc.	17478
Akrimax Pharmaceuticals, LLC	Akrimax Pharmaceuticals, LLC	24090
Alaunus Pharmaceutical, LLC	Alaunus Pharmaceutical, LLC	50690
Alcon Laboratories, Inc.	Alcon Laboratories, Inc.	00998
Alfasigma USA, Inc	Alfasigma USA, Inc	00525
Alkermes Pharma Ireland Limited	Alkermes Pharma Ireland Limited	56125
Allergan, Inc.	Allergan, Inc.	00456
Alltech Associates Inc	ALLTECH ASSOCIATES INC	00079
Almac Clinical Services LLC	Almac Clinical Services LLC	63164
Alpharma Pharmaceuticals LLC	Alpharma Pharmaceuticals LLC	63857
Altura Pharmaceuticals, Inc.	Altura Pharmaceuticals, Inc.	63874
Alvogen, Inc.	Alvogen, Inc.	47781
ALZA Corporation	ALZA Corporation	17314
AMAG Pharmaceuticals, Inc.	AMAG Pharmaceuticals, Inc.	64011
Amarin Technologies SA.	Amarin Technologies SA.	52446

Labeler Company Family	Labeler Name	NDC Labeler Code
American Health Packaging	American Health Packaging	62584
American Health Packaging	American Health Packaging	68084
American Pacific Corporation	American Pacific Corporation	50683
American Regent, Inc	American Regent, Inc.	00517
Amerifit, Inc.	Amerifit, Inc.	61451
Amneal Pharmaceuticals LLC	Amneal Pharmaceuticals Co. (I) Pvt. Ltd.	52493
Amneal Pharmaceuticals LLC	Amneal Pharmaceuticals LLC	65162
Amneal Pharmaceuticals LLC	Amneal Pharmaceuticals of New York LLC	53746
Amphastar Pharmaceuticals, Inc.	Amphastar Pharmaceuticals, Inc.	00548
AMRI Rensselaer, Inc.	AMRI Rensselaer, Inc.	65392
ANI Pharmaceuticals, Inc	ANI Pharmaceuticals, Inc	62559
Animalgesic Laboratories, Inc	Animalgesic Laboratories, Inc	86004
Aphena Pharma Solutions - Tennessee, LLC	Aphena Pharma Solutions - Tennessee, LLC	43353
Aphena Pharma Solutions - Tennessee, LLC	Aphena Pharma Solutions - Tennessee, LLC	67544
Apotex Corp.	Apotex Corp.	60505
Apotheca Inc.	Apotheca Inc.	12634
Archimedes Pharma	Archimedes Pharma	51772
A-S Medication Solutions	A-S Medication Solutions	54569
Ascend Laboratories, LLC	Ascend Laboratories, LLC	67877
AstraZeneca Pharmaceuticals LP	AstraZeneca Pharmaceuticals LP	00186
AstraZeneca Pharmaceuticals LP	AstraZeneca Pharmaceuticals LP	00310
Atlantic Biologicals Corps	Atlantic Biologicals Corps	17856
Atley Pharmaceuticals, Inc.	Atley Pharmaceuticals, Inc.	59702
Aurolife Pharma LLC	Aurolife Pharma LLC	13107
Avadel Legacy Pharmaceuticals, LLC	Avadel Legacy Pharmaceuticals, LLC	76014
Avadel Pharmaceuticals (USA), Inc.	Avadel Pharmaceuticals (USA), Inc.	13551
Aveva Drug Delivery Systems	Aveva Drug Delivery Systems	03215
AvKARE, Inc.	AvKARE, Inc.	42291
AvPAK	AvPAK	50268
B&B Pharmaceuticals, Inc.	B&B Pharmaceuticals, Inc.	63275
Ballay Pharmaceuticals, Inc	Ballay Pharmaceuticals, Inc	63162
Bausch & Lomb Incorporated	Bausch & Lomb Incorporated	24208
Baxter Healthcare Corporation	Baxter Healthcare Corporation	00338
Baxter Healthcare Corporation	Baxter Healthcare Corporation	10019

Labeler Company Family	Labeler Name	NDC Labeler Code
Baxter Healthcare Corporation	Baxter Healthcare Corporation	60977
Bayer HealthCare Pharmaceuticals Inc.	Bayer HealthCare Pharmaceuticals Inc.	50419
Bedford Laboratories	Bedford Laboratories	55390
BF Ascher and Co Inc	BF ASCHER AND CO INC	00225
BioDelivery Sciences International, Inc.	BioDelivery Sciences International, Inc.	59385
Blansett Pharmacal Co., Inc	Blansett Pharmacal Co., Inc	51674
Blenheim Pharmacal, Inc.	Blenheim Pharmacal, Inc.	10544
Boehringer Ingelheim Chemicals, Inc.	Boehringer Ingelheim Chemicals, Inc.	50019
Brava Pharmaceuticals, LLC	Brava Pharmaceuticals, LLC	57883
Breckenridge Pharmaceutical, Inc.	Breckenridge Pharmaceutical, Inc.	51991
Brighton Pharmaceuticals, Inc.	Brighton Pharmaceuticals, Inc.	10914
Bristol-Myers Squibb Holding Pharma, LLC	Bristol-Myers Squibb Holding Pharma, Ltd. Liability Company	00590
Bristol-Myers Squibb Holding Pharma, LLC	Bristol-Myers Squibb Pharma Company	00056
Bryant Ranch Prepack	Bryant Ranch Prepack	63629
ByzMed, LLC	ByzMed, LLC	58092
C.O. Truxton, Inc.	C.O. Truxton, Inc.	00463
Cambrex Charles City, Inc	Cambrex Charles City, Inc	59116
Cambridge Isotope Laboratories, Inc.	Cambridge Isotope Laboratories, Inc.	61444
Cantrell Drug Company	Cantrell Drug Company	52533
Cardinal Health	Cardinal Health	55154
CAREMARK LLC	CAREMARK LLC	00339
Cedarburg Pharmaceuticals, Inc.	Cedarburg Pharmaceuticals, Inc.	64181
Central Admixture Pharmacy Services, Inc.	Central Admixture Pharmacy Services, Inc.	66647
Centrix Pharmaceutical, Inc.	Centrix Pharmaceutical, Inc.	11528
Century Pharmaceuticals, Inc.	Century Pharmaceuticals, Inc.	00436
Cephalon, Inc.	Cephalon, Inc.	63459
Cerilliant Corporation	Cerilliant Corporation	50160
Cerovene, Inc.	Cerovene, Inc.	24561
Chattem Chemicals, Inc.	Chattem Chemicals, Inc.	61960
CIMA Labs Inc.	CIMA LABS INC.	55253
Cody Laboratories, Inc.	Cody Laboratories, Inc.	65893
CorePharma, LLC	CorePharma, LLC	64720
Corium International, Inc.CAJ	Corium International, Inc.CAJ	65038
Coupler Enterprises	Coupler Enterprises	67046
Cyalume Specialty Products	Cyalume Specialty Products	45986

Labeler Company Family	Labeler Name	NDC Labeler Code
Cypress Pharmaceutical, Inc.	Cypress Pharmaceutical, Inc.	60258
DCS Pharma AG	DCS Pharma AG	12070
Depomed, Inc.	Depomed, Inc.	13913
Direct Rx	Direct Rx	61919
Dispensing Solutions Inc.	Dispensing Solutions Inc.	55045
Dispensing Solutions Inc.	Dispensing Solutions Inc.	66336
Dispensing Solutions Inc.	Dispensing Solutions Inc.	68258
DPT Laboratories, Ltd.	DPT Laboratories, Ltd.	63094
DPT Lakewood, LLC.	DPT Lakewood, LLC.	49396
E.R. Squibb & Sons, L.L.C.	E.R. Squibb & Sons, L.L.C.	00015
e5 Pharma, LLC	e5 Pharma, LLC	13517
ECI Pharmaceuticals, LLC	ECI Pharmaceuticals, LLC	51293
ECR Pharmaceuticals Co., Inc.	ECR Pharmaceuticals Co., Inc.	00095
Edenbridge Pharmaceuticals, LLC	Edenbridge Pharmaceuticals, LLC	42799
Edwards Pharmaceuticals, Inc.	Edwards Pharmaceuticals, Inc.	00485
EKR Therapeutics, Inc.	EKR Therapeutics, Inc.	24477
Elanco Animal Health Co	Elanco Animal Health Co	00986
Elge Inc	Elge Inc	58298
Eli Lilly and Company	Eli Lilly and Company	00002
Elite Laboratories, Inc.	Elite Laboratories, Inc.	64850
Endo Pharmaceuticals, Inc.	Endo Pharmaceuticals, Inc.	63481
Eon Labs, Inc.	Eon Labs, Inc.	00185
Epic Pharma, LLC	Epic Pharma, LLC	42806
EPM Packaging Inc	EPM Packaging Inc	61502
Ethex Corporation	Ethex Corporation	58177
Ethical Nutritional, LLC	Ethical Nutritional, LLC	10191
Euticals Inc.	Euticals Inc.	17180
Exeltis USA, Inc.	Exeltis USA Dermatology, LLC	23710
Exeltis USA, Inc.	Exeltis USA, Inc.	00642
Fagron Inc	Fagron Inc	51552
Forest Laboratories, Inc.	Forest Laboratories, Inc.	00258
Forest Laboratories, Inc.	Forest Laboratories, Inc.	00785
Fougera Pharmaceuticals Inc.	Fougera Pharmaceuticals Inc.	00482
Freedom Pharmaceuticals, Inc.	Freedom Pharmaceuticals, Inc.	52372
Fresenius Kabi USA, LLC	Fresenius Kabi USA, LLC	63323
Fresenius Kabi USA, LLC	Fresenius Kabi USA, LLC	76045
G&W Laboratories, Inc.	G&W Laboratories, Inc.	00713

Labeler Company Family	Labeler Name	NDC Labeler Code
Galena Biopharma, Inc.	Galena Biopharma, Inc.	57881
GE Healthcare Inc.	GE Healthcare Inc.	00407
Gemini Laboratories, LLC	Gemini Laboratories, LLC	60846
Genentech, Inc.	Genentech, Inc.	00004
Gentex Pharma, Llc	Gentex Pharma, Llc	15014
Gil Pharmaceutical Corp	Gil Pharmaceutical Corp	58552
GlaxoSmithKline LLC	GlaxoSmithKline Consumer Healthcare Holdings (US) LLC	00043
GlaxoSmithKline LLC	GlaxoSmithKline Consumer Healthcare Holdings (US) LLC	00067
GlaxoSmithKline LLC	GlaxoSmithKline LLC	00007
GlaxoSmithKline LLC	GlaxoSmithKline LLC	00029
Glenmark Pharmaceuticals Inc., USA	Glenmark Pharmaceuticals Inc., USA	68462
GM Pharmaceuticals	GM Pharmaceuticals	58809
Golden State Medical Supply, Inc.	Golden State Medical Supply, Inc.	60429
Great Southern Laboratories	Great Southern Laboratories	51301
H.J. Harkins Co, Inc.	H.J. Harkins Co, Inc.	76519
H.J. Harkins Co, Inc.	H.J. Harkins Company, Inc.	52959
Halo Pharmaceutical, Inc	Halo Pharmaceutical, Inc	43346
Hanlim Pharm. Co., Ltd.	HANLIM PHARM. CO., LTD.	11716
Hawthorn Pharmaceuticals, Inc.	Hawthorn Pharmaceuticals, Inc.	63717
Healix Infusion Therapy, Inc.	Healix Infusion Therapy, Inc.	75901
Hercon Pharmaceuticals, LLC	Hercon Pharmaceuticals, LLC	49730
Hisamitsu Pharmaceutical Co., Inc.	Hisamitsu Pharmaceutical Co., Inc.	68560
Hi-Tech Pharmacal Co., Inc.	Hi-Tech Pharmacal Co., Inc.	50383
Horizon Pharma Inc.	Horizon Pharma Inc.	60809
Hospira, Inc.	Hospira, Inc.	00409
Hospira, Inc.	Hospira, Inc.	61703
Huckaby Pharmaceuticals, Inc.	Huckaby Pharmaceuticals, Inc.	35501
Impax Generics	Impax Generics	00115
Indivior Inc.	Indivior Inc.	12496
Innovative BioDefense, Inc.	Innovative BioDefense, Inc.	57362
Insys Therapeutics, Inc.	Insys Therapeutics, Inc.	20482
International Ethical Laboratories, Inc.	International Ethical Laboratories, Inc.	11584
International Medication Systems, Ltd.	International Medication Systems, Ltd.	76329
Janssen Pharmaceuticals, Inc.	Janssen Pharmaceuticals, Inc.	50458
JayMac Pharmaceuticals LLC	JayMac Pharmaceuticals LLC	64661
Jerome Stevens Pharmaceuticals, Inc.	Jerome Stevens Pharmaceuticals, Inc.	50564

Labeler Company Family	Labeler Name	NDC Labeler Code
Jiangsu Grand Xianle Pharmaceutical Co., Ltd.	Jiangsu Grand Xianle Pharmaceutical Co., Ltd.	59010
Johnson & Johnson Consumer Inc.	Johnson & Johnson Consumer Inc.	00081
Johnson Matthey Inc.	Johnson Matthey Inc.	49812
Johnson Matthey Inc.	Johnson Matthey Pharmaceutical Materials Conshohocken	25905
Johnson Matthey Inc.	Johnson Matthey Pharmaceuticals Services	50137
Kaiser Foundation Hospitals	KAISER FOUNDATION HOSPITALS	00179
Kalchem International Inc.	Kalchem International Inc.	60592
Keltman Pharmaceuticals	Keltman Pharmaceuticals	68387
Key Quimica S.A. de C.V.	KEY QUIMICA S.A. DE C.V.	58345
Kowa Pharmaceuticals America, Inc.	Kowa Pharmaceuticals America, Inc.	66869
Kremers Urban Pharmaceuticals Inc.	Kremers Urban Pharmaceuticals Inc.	62175
KVK-Tech, Inc.	KVK-TECH, INC.	10702
Kyowa Kirin, Inc	KYOWA KIRIN, INC,	42747
Lake Erie Medical DBA: Quality Care Products LLC	Lake Erie Medical DBA Quality Care Products LLC	55700
Lake Erie Medical DBA: Quality Care Products LLC	Lake Erie Medical DBA: Quality Care Products LLC	35356
Lake Erie Medical DBA: Quality Care Products LLC	Lake Erie Medical DBA: Quality Care Products LLC	49999
Lannett Company, Inc.	Lannett Company, Inc.	00527
Larken Laboratories, Inc	Larken Laboratories, Inc	68047
Laser Pharmaceuticals, LLC	Laser Pharmaceuticals, LLC	16477
Laser Pharmaceuticals, LLC	Laser, LLC d/b/a Laser Pharmaceuticals, LLC	00277
Lee Pharmaceuticals	Lee Pharmaceuticals	23558
Lehigh Valley Technologies, Inc.	Lehigh Valley Technologies, Inc.	64950
Letco Medical, LLC	LETCO MEDICAL, LLC	62991
Liberty Pharmaceuticals, Inc.	Liberty Pharmaceuticals, Inc.	00440
Liebel-Flarsheim Company LLC	Liebel-Flarsheim Company LLC	00019
Llorens Pharmaceutical International Division	Llorens Pharmaceutical International Division	54859
LTS Lohmann Therapy Systems Corp.	LTS Lohmann Therapie-Systeme AG	59568
LTS Lohmann Therapy Systems Corp.	LTS Lohmann Therapy Systems Corp.	60751
Lumara Health Ltd	Lumara Health Ltd	10609
Lupin Pharmaceuticals, Inc.	Lupin Pharmaceuticals, Inc.	43386
Macfarlan Smith Limited	Macfarlan Smith Limited	12707

Labeler Company Family	Labeler Name	NDC Labeler Code
MAGNA Pharmaceuticals, Inc.	MAGNA Pharmaceuticals, Inc.	58407
Major Pharmaceuticals	Major Pharmaceuticals	00904
Marathon Pharmaceuticals, LLC	Marathon Pharmaceuticals, LLC	42998
Marnel Pharmaceuticals, LLC	Marnel Pharmaceuticals, LLC	00682
Mayne Pharma Inc.	Mayne Pharma Inc.	51862
Mayne Pharma Inc.	Mayne Pharma Inc.	68308
McKesson Corporation	McKesson Contract Packaging	76237
McKesson Corporation	McKesson Corporation	63739
MCR American Pharmaceuticals, Inc.	MCR American Pharmaceuticals, Inc.	58605
Meda Pharmaceuticals Inc.	Meda Pharmaceuticals Inc.	00037
MedImmune, LLC	MedImmune, LLC	58178
Medisca Inc.	Medisca Inc.	38779
Medsource Pharmaceuticals	Medsource Pharmaceuticals	45865
MedVantx, Inc.	MedVantx, Inc.	66116
Meridian Medical Technologies , Inc.	Meridian Medical Technologies , Inc.	11704
Merz Pharmaceuticals, LLC	Merz Pharmaceuticals, LLC	00259
Micro Orgo Chemicals	Micro Orgo Chemicals	16447
Mikart, Inc.	Mikart, Inc.	46672
Misemer Pharmaceutical, Inc.	Misemer Pharmaceutical, Inc.	00276
Morton Grove Pharmaceuticals, Inc.	Morton Grove Pharmaceuticals, Inc.	60432
Mylan Institutional Inc.	Mylan Institutional Inc.	51079
Mylan Institutional Inc.	Mylan Institutional LLC	67457
Mylan Pharmaceuticals, Inc.	Mylan Pharmaceuticals, Inc.	00378
Mylan Specialty L.P.	Mylan Specialty L.P.	49502
N V Organon	N V Organon	12860
Neos Therapeutics, LP	Neos Therapeutics, LP	62542
Nexcyon Pharmaceuticals, Inc.	Nexcyon Pharmaceuticals, Inc.	50929
Nexgen Pharma, Inc.	Nexgen Pharma, Inc.	00722
Nibec Co., Ltd	Nibec Co., Ltd	47649
Noramco, Inc.	Noramco, Inc.	51634
Northwind Pharmaceuticals	Northwind Pharmaceuticals	51655
Nostrum Laboratories, Inc.	Nostrum Laboratories, Inc.	70408
Novartis Pharmaceuticals Corporation	Novartis Pharmaceuticals Corporation	00078
Noven Pharmaceuticals, Inc.	Noven Pharmaceuticals, Inc.	57616
NuCare Pharmaceuticals, Inc.	Nucare Pharmaceuticals Inc	68071
NuCare Pharmaceuticals, Inc.	NuCare Pharmaceuticals, Inc.	66267
Orexo US, Inc.	Orexo US, Inc.	54123

Labeler Company Family	Labeler Name	NDC Labeler Code
Ortho McNeil Pharmaceuticals	Ortho McNeil Pharmaceuticals	00045
Ortho McNeil Pharmaceuticals	Ortho-McNeil Pharmaceuticals	00062
Oscar de la Renta LLC	Oscar de la Renta LLC	45124
Pacira Pharmaceuticals, Inc.	Pacira Pharmaceuticals, Inc.	65250
Paddock Laboratories, LLC.	Paddock Laboratories, LLC.	00574
Palmetto Pharmaceuticals, Inc	Palmetto Pharmaceuticals, Inc	68134
Par Pharmaceutical	Par Pharmaceutical	00603
Par Pharmaceutical	Par Pharmaceutical	49884
Par Pharmaceutical	Par Pharmaceutical	60951
Par Pharmaceutical	Par Pharmaceutical	64376
Par Pharmaceutical	Par Pharmaceutical	67253
Par Pharmaceutical	Par Pharmaceutical	68774
Par Pharmaceutical	Par Pharmaceutical Inc.	00254
Par Pharmaceutical	Par Pharmaceutical Inc.	42023
ParaPRO LLC	ParaPRO LLC	52246
Parke-Davis Div of Pfizer Inc	Parke-Davis Div of Pfizer Inc	00071
PD-Rx Pharmaceuticals, Inc.	PD-Rx Pharmaceuticals, Inc.	43063
PD-Rx Pharmaceuticals, Inc.	PD-Rx Pharmaceuticals, Inc.	55289
Pernix Therapeutics, LLC	Pernix Therapeutics, LLC	65224
Pfizer Laboratories Div Pfizer Inc	Pfizer Laboratories Div Pfizer Inc	60793
Pfizer Laboratories Div Pfizer Inc	Pfizer Laboratories Div Pfizer Inc	61570
Pharmaceutical Associates, Inc.	Pharmaceutical Associates, Inc.	00121
Pharmaceutical Manufacturing Research Services, Inc.	Pharmaceutical Manufacturing Research Services, Inc.	61607
Pharmaceutics International, Inc. (Pii)	Pharmaceutics International, Inc. (Pii)	61916
Pharmacia and Upjohn Company LLC	Pharmacia and Upjohn Company LLC	00009
PharmaForce, Inc.	PharmaForce, Inc.	40042
PharMEDium Services LLC	PharMEDium Services LLC	61553
Pharmics, Inc.	Pharmics, Inc.	00813
PharmPak, Inc.	PharmPak, Inc.	54348
Physician Therapeutics LLC	Physician Therapeutics LLC	68405
Physicians Total Care, Inc	PHYSICIANS TOTAL CARE, INC	54868
Poly Pharmaceuticals, Inc.	Poly Pharmaceuticals, Inc.	50991
Prasco Laboratories	Prasco Laboratories	66993
Precision Dose Inc.	Precision Dose Inc.	68094
Preferred Pharmaceuticals Inc	Preferred Pharmaceuticals Inc	68788
Prepackage Specialists	Prepackage Specialists	58864

Labeler Company Family	Labeler Name	NDC Labeler Code
Professional Compounding Centers of America dba PCCA	Professional Compounding Centers of America dba PCCA	51927
Proficient Rx LP	Proficient Rx LP	63187
Pro-Pharma LLC	Pro-Pharma LLC	66594
Purdue Pharma LP	Purdue Pharma LP	59011
Purdue Pharma LP	Purdue Pharmaceuticals LP	65505
R.A. McNeil Company	R.A. McNeil Company	12830
Rebel Distributors Corp.	Rebel Distributors Corp.	21695
Rebel Distributors Corp.	Rebel Distributors Corp.	42254
Reckitt Benckiser LLC	Reckitt Benckiser Healthcare UK Limited	52031
Reckitt Benckiser LLC	Reckitt Benckiser LLC	63824
Recro Gainesville LLC	Recro Gainesville LLC	60274
RedPharm Drug, Inc	RedPharm Drug, Inc	67296
RemedyRepack	RemedyRepack	24236
RemedyRepack	RemedyRepack	49349
RemedyRepack	RemedyRepack Inc.	52125
Rhodes Pharmaceuticals	Rhodes Pharmaceuticals	42858
Rhodes Technologies Inc.	Rhodes Technologies Inc.	67509
Rising Pharmaceuticals, Inc.	Rising Pharmaceuticals, Inc.	64980
River's Edge Pharmaceuticals, LLC	River's Edge Pharmaceuticals, LLC	68032
RPK Pharmaceuticals, Inc	RPK Pharmaceuticals, Inc	53002
Rugby Laboratories	Rugby Laboratories	00536
Rx Pak Division of McKesson Corporation	McKesson Corporation RxPak	65084
RxChange Co.	RxChange Co.	33358
Safecor Health, LLC	Safecor Health, LLC	48433
Sandoz Inc	Sandoz Inc	00781
Sanofi-Aventis U.S. LLC	sanofi-aventis U.S. LLC	00024
Sanofi-Aventis U.S. LLC	Sanofi-Aventis U.S. LLC	00068
SCA Pharmaceuticals, LLC	SCA Pharmaceuticals, LLC	70004
Sciarra Laboratories, Inc.	Sciarra Laboratories, Inc.	61498
SCOT-TUSSIN Pharmacal Co., Inc.	SCOT-TUSSIN Pharmacal Co., Inc.	00372
Sentynl Therapeutics, Inc.	Sentynl Therapeutics, Inc.	42358
Shanghai Kejing Cleaning Products Co., Ltd.	Shanghai Kejing Cleaning Products Co., Ltd.	31190
Shionogi Inc.	Shionogi Inc.	59630
Shire US Manufacturing Inc.	Shire US Manufacturing Inc.	54092

Labeler Company Family	Labeler Name	NDC Labeler Code
Siegfried (USA), Inc.	Siegfried (USA), Inc.	00792
Siegfried (USA), Inc.	Siegfried Ltd	17205
Sigma-Aldrich Corporation	Sigma-Aldrich Corporation	00441
Sircle Laboratories, LLC	Sircle Laboratories, LLC	51021
SJ Pharmaceuticals, LLC	SJ Pharmaceuticals, LLC	24839
Sovereign Pharmaceuticals, LLC	Sovereign Pharmaceuticals, LLC	58716
SpecGx LLC	SpecGx LLC	00406
SpecGx LLC	SpecGx LLC	23635
Spectrum Chemical and Laboratory Products	Spectrum Chemical and Laboratory Products	49452
St. Mary's Medical Park Pharmacy	St. Mary's Medical Park Pharmacy	60760
STAT Rx USA LLC	STAT Rx USA LLC	16590
STAT Rx USA LLC	STAT Rx USA LLC	42549
Stewart-Jackson Pharmacal, Inc.	Stewart-Jackson Pharmacal, Inc.	45985
Sun Pharmaceutical Industries, Inc.	Sun Pharmaceutical Industries Inc.	53489
Sun Pharmaceutical Industries, Inc.	Sun Pharmaceutical Industries, Inc.	49708
Sun Pharmaceutical Industries, Inc.	Sun Pharmaceutical Industries, Inc.	57664
Sun Pharmaceutical Industries, Inc.	Sun Pharmaceutical Industries, Inc.	63304
Sunrise Pharmaceutical Inc.	Sunrise Pharmaceutical Inc.	11534
Supernus Pharmaceuticals, Inc.	Supernus Pharmaceuticals, Inc.	17772
Susanne Lang Fragrance Inc.	Susanne Lang Fragrance Inc.	47202
TAGI Pharma, Inc.	TAGI Pharma, Inc.	51224
Talec Pharma, LLC	Talec Pharma, LLC	76181
Tedor Pharma Inc.	Tedor Pharma Inc.	67433
Teva Czech Industries s.r.o.	Teva Czech Industries s.r.o.	47848
Teva Pharmaceuticals USA, Inc.	Teva Parenteral Medicines, Inc.	00703
Teva Pharmaceuticals USA, Inc.	Teva Pharmaceuticals USA, Inc.	00093
Teva Pharmaceuticals USA, Inc.	Teva Pharmaceuticals USA, Inc.	00172
Teva Pharmaceuticals USA, Inc.	Teva Pharmaceuticals USA, Inc.	00182
Teva Pharmaceuticals USA, Inc.	Teva Pharmaceuticals USA, Inc.	00555
Teva Pharmaceuticals USA, Inc.	Teva Respiratory, LLC	59310
Teva Pharmaceuticals USA, Inc.	Teva Women's Health, Inc.	51285
The United States Pharmacopeial Convention	The United States Pharmacopeial Convention	00216
Tiber Laboratories, LLC	Tiber Laboratories, LLC	23589
Trigen Laboratories, LLC	Trigen Laboratories, LLC	13811
Tris Pharma Inc	Tris Pharma Inc	27808
UCB, Inc.	UCB, Inc.	00091

Labeler Company Family	Labeler Name	NDC Labeler Code
UCB, Inc.	UCB, Inc.	00131
UCB, Inc.	UCB, Inc.	50474
Unit Dose Services	Unit Dose Services	50436
United Research Laboratories, Inc.	United Research Laboratories, Inc.	00677
Unither Manufacturing LLC	Unither Manufacturing LLC	53014
University of Iowa Pharmaceuticals	University of Iowa Pharmaceuticals	11326
Upsher-Smith Laboratories, LLC	Upsher-Smith Laboratories, LLC	00245
Upsher-Smith Laboratories, LLC	Upsher-Smith Laboratories, LLC	00832
US Compounding, Inc	US Compounding, Inc	62295
VA CMOP Dallas	VA CMOP Dallas	65243
Valeant Pharmaceuticals North America LLC	Valeant Pharmaceuticals North America LLC	00187
Vanguard Labs	Vanguard Labs	00615
Vertical Pharmaceuticals, LLC	Vertical Pharmaceuticals, LLC	68025
Victory Pharma, Inc.	Victory Pharma, Inc.	68453
Vision Pharma, LLC	Vision Pharma, LLC	68013
VistaPharm Inc.	VistaPharm Inc.	66689
Warner Chilcott Pharmaceuticals Inc.	Warner Chilcott Pharmaceuticals Inc.	00149
Watson Pharma, Inc.	Watson Pharma, Inc.	71114
West-Ward Pharmaceuticals Corp.	West-ward Pharmaceutical Corp	00143
West-Ward Pharmaceuticals Corp.	West-ward Pharmaceutical Corp.	00641
West-Ward Pharmaceuticals Corp.	West-Ward Pharmaceuticals Corp.	00054
Whitney Labs, LP	Whitney Labs, LP	57256
WraSer Pharmaceuticals	WraSer Pharmaceuticals	66992
Wyeth Pharmaceuticals Inc., a subsidiary of Pfizer Inc.	Richmond Division of Wyeth	00031
Wyeth Pharmaceuticals Inc., a subsidiary of Pfizer Inc.	Wyeth Pharmaceutical Division of Wyeth Holdings Corporation, a subsidiary of Pfizer Inc.	00005
Wyeth Pharmaceuticals Inc., a subsidiary of Pfizer Inc.	Wyeth Pharmaceuticals LLC, a subsidiary of Pfizer Inc.	00008
Wyeth Pharmaceuticals Inc., a subsidiary of Pfizer Inc.	Wyeth Pharmaceuticals LLC, a subsidiary of Pfizer Inc.	00046
Xanodyne Pharmaceuticals, Inc.	Xanodyne Pharmaceuticals, Inc.	66479
Zogenix, Inc.	Zogenix, Inc.	43376
Zydus Pharmaceuticals (USA) Inc.	Zydus Pharmaceuticals (USA) Inc.	68382

Source:

Labeler Company Family	Labeler Name	NDC Labeler Code
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The Labeler Name and NDC Labeler Code are from the list of NDC/NHRIC Labeler Codes available at <https://www.fda.gov/ForIndustry/DataStandards/StructuredProductLabeling/ucm191017.htm>. I accessed the file on May 25, 2018. The NDC Labeler Code is the first five digits of the NDC.

Appendix 6: List of Reporter Company Families

Seller Family	Seller Name	Seller DEA Number
AmerisourceBergen Drug	AMERISOURCEBERGEN DRUG	RA0322824
AmerisourceBergen Drug	AMERISOURCEBERGEN DRUG	RA0326276
AmerisourceBergen Drug	AMERISOURCEBERGEN DRUG CORP	PL0032627
AmerisourceBergen Drug	AMERISOURCEBERGEN DRUG CORP	RA0129937
AmerisourceBergen Drug	AMERISOURCEBERGEN DRUG CORP	RA0210409
AmerisourceBergen Drug	AMERISOURCEBERGEN DRUG CORP	RA0223432
AmerisourceBergen Drug	AMERISOURCEBERGEN DRUG CORP	RA0289000
AmerisourceBergen Drug	AMERISOURCEBERGEN DRUG CORP	RA0289036
AmerisourceBergen Drug	AMERISOURCEBERGEN DRUG CORP	RA0289048
AmerisourceBergen Drug	AMERISOURCEBERGEN DRUG CORP	RA0289050
AmerisourceBergen Drug	AMERISOURCEBERGEN DRUG CORP	RA0289062
AmerisourceBergen Drug	AMERISOURCEBERGEN DRUG CORP	RA0289074
AmerisourceBergen Drug	AMERISOURCEBERGEN DRUG CORP	RA0289086
AmerisourceBergen Drug	AMERISOURCEBERGEN DRUG CORP	RA0289098
AmerisourceBergen Drug	AMERISOURCEBERGEN DRUG CORP	RA0289276
AmerisourceBergen Drug	AMERISOURCEBERGEN DRUG CORP	RA0289288
AmerisourceBergen Drug	AMERISOURCEBERGEN DRUG CORP	RA0289492
AmerisourceBergen Drug	AMERISOURCEBERGEN DRUG CORP	RA0290522
AmerisourceBergen Drug	AMERISOURCEBERGEN DRUG CORP	RA0290724
AmerisourceBergen Drug	AMERISOURCEBERGEN DRUG CORP	RA0290736
AmerisourceBergen Drug	AMERISOURCEBERGEN DRUG CORP	RA0290837
AmerisourceBergen Drug	AMERISOURCEBERGEN DRUG CORP	RA0290938
AmerisourceBergen Drug	AMERISOURCEBERGEN DRUG CORP	RA0290988
AmerisourceBergen Drug	AMERISOURCEBERGEN DRUG CORP	RA0291168
AmerisourceBergen Drug	AMERISOURCEBERGEN DRUG CORP	RA0291170
AmerisourceBergen Drug	AMERISOURCEBERGEN DRUG CORP	RA0310603
AmerisourceBergen Drug	AMERISOURCEBERGEN DRUG CORP	RA0314562
AmerisourceBergen Drug	AMERISOURCEBERGEN DRUG CORP	RA0363301
AmerisourceBergen Drug	AMERISOURCEBERGEN DRUG CORP	RB0363630
AmerisourceBergen Drug	AMERISOURCEBERGEN DRUG CORP	RE0161733
AmerisourceBergen Drug	AMERISOURCEBERGEN DRUG CORP.	RA0336924
AmerisourceBergen Drug	AMERISOURCEBERGEN DRUG CORPORATION	RA0316958
AmerisourceBergen Drug	AMERISOURCEBERGEN DRUG CORPORATION	RA0464406
Anda, Inc	ANDA PHARMACEUTICALS INC	RA0287020

Seller Family	Seller Name	Seller DEA Number
Anda, Inc	ANDA PUERTO RICO, INC.	RA0394748
Anda, Inc	ANDA, INC	RA0180733
Cardinal Health	CARDINAL HEALTH	RC0182080
Cardinal Health	CARDINAL HEALTH	RC0221236
Cardinal Health	CARDINAL HEALTH	RC0229965
Cardinal Health	CARDINAL HEALTH	RC0238104
Cardinal Health	CARDINAL HEALTH	RC0271267
Cardinal Health	CARDINAL HEALTH	RC0311693
Cardinal Health	CARDINAL HEALTH	RC0313940
Cardinal Health	CARDINAL HEALTH	RC0314891
Cardinal Health	CARDINAL HEALTH	RC0333524
Cardinal Health	CARDINAL HEALTH	RC0341153
Cardinal Health	CARDINAL HEALTH	RC0346658
Cardinal Health	CARDINAL HEALTH	RC0403802
Cardinal Health	CARDINAL HEALTH	RD0108200
Cardinal Health	CARDINAL HEALTH	RN0209583
Cardinal Health	CARDINAL HEALTH	RN0231427
Cardinal Health	CARDINAL HEALTH	RN0281054
Cardinal Health	CARDINAL HEALTH	RO0153609
Cardinal Health	CARDINAL HEALTH	RW0191407
Cardinal Health	CARDINAL HEALTH	RW0191419
Cardinal Health	CARDINAL HEALTH	RW0191813
Cardinal Health	CARDINAL HEALTH	RW0191926
Cardinal Health	CARDINAL HEALTH	RW0216449
Cardinal Health	CARDINAL HEALTH	RW0231908
Cardinal Health	CARDINAL HEALTH	RW0234928
Cardinal Health	CARDINAL HEALTH	RW0236009
Cardinal Health	CARDINAL HEALTH	RW0243725
Cardinal Health	CARDINAL HEALTH	RW0243903
Cardinal Health	CARDINAL HEALTH	RW0263056
Cardinal Health	CARDINAL HEALTH	RW0263549
Cardinal Health	CARDINAL HEALTH	RW0269654
Cardinal Health	CARDINAL HEALTH	RW0279996
Cardinal Health	CARDINAL HEALTH	RW0283452
Cardinal Health	CARDINAL HEALTH 110	PT0186038
Cardinal Health	CARDINAL HEALTH 110, LLC	PC0003044
Cardinal Health	CARDINAL HEALTH 110, LLC	RK0416900

Seller Family	Seller Name	Seller DEA Number
Cardinal Health	CARDINAL HEALTH 110, LLC	RP0337370
Cardinal Health	CARDINAL HEALTH P.R. 120, INC.	RB0374683
Cardinal Health	CARDINAL HEALTH, INC.	RW0286333
CVS	CVS INDIANA	RH0197170
CVS	CVS ORLANDO FL DISTRIBUTION	RC0318128
CVS	CVS PHARMACY INC	PM0124723
CVS	CVS PHARMACY INC	RC0347725
CVS	CVS PHARMACY, INC	RC0275467
CVS	CVS PHARMACY, INC.	RC0315108
CVS	CVS PHARMACY, INC.	RM0145347
CVS	CVS RX SERVICES, INC	RC0415871
CVS	CVS TN DISTRIBUTION, LLC	PR0205559
CVS	CVS VERO FL DISTRIBUTION, L.L.C	RC0338031
CVS	CVS VERO FL DISTRIBUTION, L.L.C.	RC0469292
Discount Drug Mart	DISCOUNT DRUG MART	PD0203377
H. D. Smith	H D SMITH WHOLESALE DRUG CO	PH0035964
H. D. Smith	H D SMITH WHOLESALE DRUG CO	RB0268486
H. D. Smith	H D SMITH WHOLESALE DRUG CO	RH0225056
H. D. Smith	H D SMITH WHOLESALE DRUG CO	RS0269236
H. D. Smith	H D SMITH WHOLESALE DRUG CO.	RH0323775
H. D. Smith	H D SMITH WHOLESALE DRUG COMPANY	RH0366460
H. D. Smith	H. D. SMITH	RH0340896
H. D. Smith	H. D. SMITH	RH0344781
H. D. Smith	H. D. SMITH WHOLESALE DRUG	RH0347282
H. D. Smith	HD SMITH TEXAS DIVISION	PT0027296
H. D. Smith	SMITH MEDICAL PARTNERS LLC	RS0375344
HBC Service Company	HBC SERVICE COMPANY	RH0389773
Henry Schein Inc	HENRY SCHEIN ANIMAL HEALTH	RB0393912
Henry Schein Inc	HENRY SCHEIN ANIMAL HEALTH	RB0394938
Henry Schein Inc	HENRY SCHEIN ANIMAL HEALTH	RB0394940
Henry Schein Inc	HENRY SCHEIN ANIMAL HEALTH	RB0395219
Henry Schein Inc	HENRY SCHEIN INC	RH0162494
Henry Schein Inc	HENRY SCHEIN INC	RH0181709
Henry Schein Inc	HENRY SCHEIN INC	RH0284199
Henry Schein Inc	HENRY SCHEIN, INC	RH0236667
Henry Schein Inc	HENRY SCHEIN, INC	RH0238192
McKesson Corporation	MCKESSON BIO SERVICES	RM0247468

Seller Family	Seller Name	Seller DEA Number
McKesson Corporation	MCKESSON CORPORATION	PD0029567
McKesson Corporation	MCKESSON CORPORATION	PF0000012
McKesson Corporation	MCKESSON CORPORATION	PM0000771
McKesson Corporation	MCKESSON CORPORATION	PM0001014
McKesson Corporation	MCKESSON CORPORATION	PM0001951
McKesson Corporation	MCKESSON CORPORATION	PM0003094
McKesson Corporation	MCKESSON CORPORATION	PM0018425
McKesson Corporation	MCKESSON CORPORATION	PM0020850
McKesson Corporation	MCKESSON CORPORATION	PM0021131
McKesson Corporation	MCKESSON CORPORATION	PM0021535
McKesson Corporation	MCKESSON CORPORATION	PM0022929
McKesson Corporation	MCKESSON CORPORATION	PM0023046
McKesson Corporation	MCKESSON CORPORATION	PM0030849
McKesson Corporation	MCKESSON CORPORATION	PM0037374
McKesson Corporation	MCKESSON CORPORATION	PM0038693
McKesson Corporation	MCKESSON CORPORATION	PM0150538
McKesson Corporation	MCKESSON CORPORATION	PR0040357
McKesson Corporation	MCKESSON CORPORATION	PR0104593
McKesson Corporation	MCKESSON CORPORATION	RM0138328
McKesson Corporation	MCKESSON CORPORATION	RM0173055
McKesson Corporation	MCKESSON CORPORATION	RM0207286
McKesson Corporation	MCKESSON CORPORATION	RM0220537
McKesson Corporation	MCKESSON CORPORATION	RM0220599
McKesson Corporation	MCKESSON CORPORATION	RM0220688
McKesson Corporation	MCKESSON CORPORATION	RM0227430
McKesson Corporation	MCKESSON CORPORATION	RM0258601
McKesson Corporation	MCKESSON CORPORATION	RM0328408
McKesson Corporation	MCKESSON CORPORATION	RM0335869
McKesson Corporation	MCKESSON CORPORATION	RM0336950
McKesson Corporation	MCKESSON CORPORATION	RM0337534
McKesson Corporation	MCKESSON CORPORATION	RM0354958
McKesson Corporation	MCKESSON CORPORATION	RM0380484
McKesson Corporation	MCKESSON CORPORATION	RM0421557
McKesson Corporation	MCKESSON CORPORATION	RM0424363
McKesson Corporation	MCKESSON CORPORATION	RM0456411
McKesson Corporation	MCKESSON DRUG COMPANY	PM0036334
McKesson Corporation	MCKESSON MEDICAL SURGICAL INC	RM0283313

Seller Family	Seller Name	Seller DEA Number
McKesson Corporation	MCKESSON MEDICAL-SURGICAL INC	RG0223937
McKesson Corporation	MCKESSON PACKAGING SERVICES	RM0306541
McKesson Corporation	MCKESSON SPECIALTY CARE DISTRIBUTION CORPORATION	RO0338889
McKesson Corporation	MCKESSON SPECIALTY DIST LLC	RM0339831
McKesson Corporation	MCKESSON SPECIALTY DISTRIBUTION, LLC	RM0291207
McKesson Corporation	MCKESSON SPECIALTY LOGISTICS	RM0301515
McKesson Corporation	MCKESSON TRADING COMPANY	RM0212857
McKesson Corporation	RX PAK DIV OF MCKESSON CORP	RR0276837
McKesson Corporation	WATSON PHARMA INC	RS0104517
Prescription Supply Inc	PRESCRIPTION SUPPLY INC	PP0031904
Rite Aid	RITE AID DAYVILLE DISTRIBUTION CENTER	RR0355277
Rite Aid	RITE AID MID-ATLANTIC	RR0236073
Walgreen Co	WALGREEN ARIZONA DRUG CO	PW0221084
Walgreen Co	WALGREEN CO	PW0122262
Walgreen Co	WALGREEN CO	PW0211158
Walgreen Co	WALGREEN CO	RW0152467
Walgreen Co	WALGREEN CO	RW0204026
Walgreen Co	WALGREEN CO	RW0277752
Walgreen Co	WALGREEN CO	RW0281953
Walgreen Co	WALGREEN CO	RW0294493
Walgreen Co	WALGREEN CO	RW0308216
Walgreen Co	WALGREEN CO.	RW0340757
Walgreen Co	WALGREEN CO.	RW0347496
Walgreen Co	WALGREEN EASTERN CO INC	RW0161872
Walgreen Co	WALGREEN EASTERN CO., INC.	RW0376170
Wal-Mart	WAL-MART PHARM WAREHOUSE #1	PW0186785
Wal-Mart	WAL-MART PHARMACY WAREHOUSE	RW0133479
Wal-Mart	WAL-MART PHARMACY WAREHOUSE	RW0165731
Wal-Mart	WAL-MART PHARMACY WHSE #45	RW0282145
Wal-Mart	WAL-MART PHCY WAREHOUSE #46	RW0199908
Wal-Mart	WAL-MART WAREHOUSE #32	RW0186278

Appendix 7: Description of Fields in Defendant Transaction Data

	Buyer Information		
	Buyer DEA Number	Buyer Name	Buyer Address
Anda, Inc	✓	✓	✓
AmerisourceBergen Drug			✓
Cardinal Health	✓	✓	✓
CVS			✓
Discount Drug Mart	✓	✓	✓
HBC Service Company	✓		✓
H. D. Smith	✓	✓	✓
Henry Schein		✓	✓
McKesson Corporation	✓	✓	✓
Prescription Supply Inc	✓	✓	✓
Rite Aid			
Walgreens	✓		
Walmart	✓		

	Transaction Information		
	NDC	Transaction or Invoice Date	Quantity
Anda, Inc	✓	✓	✓
AmerisourceBergen Drug	✓	✓	✓
Cardinal Health	✓	✓	✓
CVS	✓	✓	✓
Discount Drug Mart	✓	✓	✓
HBC Service Company	✓	✓	✓
H. D. Smith	✓	✓	✓
Henry Schein		✓	✓
McKesson Corporation	✓	✓	✓
Prescription Supply Inc	✓	✓	✓
Rite Aid	✓	✓	✓
Walgreens	✓	✓	✓
Walmart	✓	✓	✓

Additional Transaction Information			
	Drug Description	Transaction Code (Buy/Sell)	Action Indicator (Adjust/Delete)
Anda, Inc	✓	✓	
AmerisourceBergen Drug	✓		
Cardinal Health	✓		
CVS	✓		
Discount Drug Mart		✓	✓
HBC Service Company			
H. D. Smith	✓		
Henry Schein	✓		
McKesson Corporation			
Prescription Supply Inc	✓		
Rite Aid	✓		
Walgreens	✓	✓	✓
Walmart	✓	✓	✓

Seller Information			
	Seller DEA Number	Seller Name	Seller Address
Anda, Inc	✓	✓	✓
AmerisourceBergen Drug			
Cardinal Health	✓	✓	
CVS			
Discount Drug Mart	✓	✓	✓
HBC Service Company			
H. D. Smith			
Henry Schein			
McKesson Corporation			
Prescription Supply Inc			
Rite Aid			
Walgreens	✓		
Walmart			

Appendix 8: MME Conversion Factors (from CDC)Opioid Oral Morphine Milligram Equivalent (MME) Conversion Factors^{1,2}

<u>Type of Opioid (strength units)</u>	<u>MME Conversion Factor</u>
Buprenorphine film/tablet ³ (mg)	30
Buprenorphine patch ⁴ (mcg/hr)	12.6
Buprenorphine film (mcg)	0.03
Butorphanol (mg)	7
Codeine (mg)	0.15
Dihydrocodeine (mg)	0.25
Fentanyl buccal or SL tablets, or lozenge/troche ⁵ (mcg)	0.13
Fentanyl film or oral spray ⁶ (mcg)	0.18
Fentanyl nasal spray ⁷ (mcg)	0.16
Fentanyl patch ⁸ (mcg)	7.2
Hydrocodone (mg)	1
Hydromorphone (mg)	4
Levorphanol tartrate (mg)	11
Meperidine hydrochloride (mg)	0.1
Methadone ⁹ (mg)	3
>0, <= 20	4
>20, <=40	8
>40, <=60	10
>60	12
Morphine (mg)	1
Opium (mg)	1
Oxycodone (mg)	1.5
Oxymorphone (mg)	3
Pentazocine (mg)	0.37
Tapentadol ¹⁰ (mg)	0.4
Tramadol (mg)	0.1

¹ The MME conversion factor is intended only for analytic purposes where prescription data is used to calculate daily MME. It is to be used in the formula: Strength per Unit X (Number of Units/ Days Supply) X MME conversion factor = MME/Day. This value does not constitute clinical guidance or recommendations for converting patients from one form of opioid analgesic to another. Please consult the manufacturer's full prescribing information for such guidance. Use of this file for the purposes of any clinical decision-making warrants caution.

² National Center for Injury Prevention and Control. CDC compilation of benzodiazepines, muscle relaxants, stimulants, zolpidem, and opioid analgesics with oral morphine milligram equivalent conversion factors, 2016 version. Atlanta, GA: Centers for Disease Control and Prevention; 2016. Available at <https://www.cdc.gov/drugoverdose/media/>. For more information, send an email to Mbohm@cdc.gov.

³ Buprenorphine formulations with a FDA approved indication for Medication Assisted Treatment (MAT) are excluded from Medicare's Overutilization Monitoring System's opioid overutilization reporting.

⁴ The MME conversion factor for buprenorphine patches is based on the assumption that one milligram of parenteral buprenorphine is equivalent to 75 milligrams of oral morphine and that one patch delivers the dispensed micrograms per hour over a 24 hour day. Example: 5 ug/hr buprenorphine patch X 24 hrs = 120 ug/day buprenorphine = 0.12 mg/day = 9 mg/day oral MME. In other words, the conversion factor not accounting for days of use would be 9/5 or 1.8.

However, since the buprenorphine patch remains in place for 7 days, we have multiplied the conversion factor by 7 ($1.8 \times 7 = 12.6$). In this example, MME/day for four 5 ug/hr buprenorphine patches dispensed for use over 28 days would work out as follows: Example: 5 ug/hr buprenorphine patch X (4 patches/28 days) X 12.6 = 9 MME/day. Please note that because this allowance has been made based on the typical dosage of one buprenorphine patch per 7 days, you should first change all Days Supply in your prescription data to follow this standard, i.e., Days Supply for buprenorphine patches = # of patches x 7.

⁵ The MME conversion factor for fentanyl buccal tablets, sublingual tablets, and lozenges/troche is 0.13. This conversion factor should be multiplied by the number of micrograms in a given tablet or lozenge/troche.

⁶ The MME conversion factor for fentanyl film and oral spray is 0.18. This reflects a 40% greater bioavailability for films compared to lozenges/tablets and 38% greater bioavailability for oral sprays compared to lozenges/tablets.

⁷ The MME conversion factor for fentanyl nasal spray is 0.16, which reflects a 20% greater bioavailability for sprays compared to lozenges/tablets.

⁸ The MME conversion factor for fentanyl patches is based on the assumption that one milligram of parenteral fentanyl is equivalent to 100 milligrams of oral morphine and that one patch delivers the dispensed micrograms per hour over a 24 hour day. Example: 25 ug/hr fentanyl patch X 24 hrs = 600 ug/day fentanyl = 60 mg/day oral morphine milligram equivalent.

In other words, the conversion factor not accounting for days of use would be 60/25 or 2.4.

However, since the fentanyl patch remains in place for 3 days, we have multiplied the conversion factor by 3 ($2.4 \times 3 = 7.2$). In this example, MME/day for ten 25 ug/hr fentanyl patches dispensed for use over 30 days would work out as follows:

Example: 25 ug/hr fentanyl patch X (10 patches/30 days) X 7.2 = 60 MME/day. Please note that because this allowance has been made based on the typical dosage of one fentanyl patch per 3 days, you should first change all Days Supply in your prescription data to follow this standard, i.e., Days Supply for fentanyl patches = # of patches X 3.

⁹ The CDC MME conversion factor to calculate morphine milligram equivalents is 3. CMS uses this conversion factor when analyzing Medicare population opioid use. CMS uses the graduated methadone MME conversion factors to calculate MME within the Overutilization Monitoring System (OMS) for identifying and reporting potential opioid overutilizers. https://www.cdc.gov/drugoverdose/pdf/calculating_total_daily_dose-a.pdf.

¹⁰ Tapentadol is a mu receptor agonist and norepinephrine reuptake inhibitor. Oral MMEs are based on degree of mu-receptor agonist activity, but it is unknown if this drug is associated with overdose in the same dose-dependent manner as observed with medications that are solely mu receptor agonists

Appendix 9: Additional Expert Report Figures and Charts

Attached as separate 3,877-page PDF.

Appendix 10: Distributor Flagged Transaction Reports

Attached as separate 1,260-page PDF.

Appendix 11: Chain Distributor Flagged Transaction Reports

Attached as separate 540-page PDF.

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